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ACTIVITY-BASED COSTING FOR AGILE MANUFACTURING CONTROL

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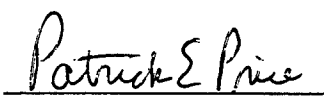

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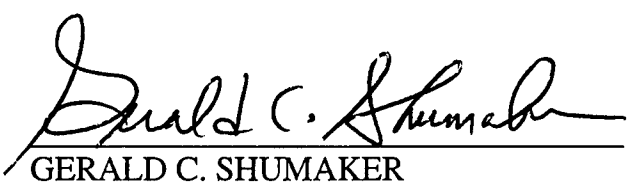

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13. ABSTRACT

The purpose of this project is to determine and quantify the costs and benefits of using Activity-Based Costing (ABC) in a small company environment to support an agile manufacturing strategy. This project demonstrated the potential of ABC in assisting small, agile manufacturers by implementing ABC in a sample of companies, measuring implementation costs, and quantifying the long term impact for the company.

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Overhead, Activity-Based Costing (ABC), Indirect Costs, Cost Flow, Costing Template.

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1.0 Executive Summary

The project started on 3-1-95 and ended 1-31-97. The final report was completed 3-17-98.

The project plan was to install Activity Based Costing (ABC) systems in 3 production machining companies and 3 plastic injection-molding companies and measure the success and impact ABC had on operations. We are continuing to have contact with and work with the 6 companies that participated in the project.

Summary of activities and results:

3 production machining companies and 3 plastic injection molding companies were selected and sold on participating in this project.
The ABC models were developed and delivered to all 6 companies.
We made minor revisions in 3 of the models to reflect changing conditions in the companies.
We are continuing to work with all 6 companies to help them better understand and utilize the model and the ABC information.
We measured impacts, but the impacts while significant were easily quantifiable and the impacts occurred in unexpected areas.
We learned a lot about how to and how not to design and implement ABC in small manufacturing companies. This information has helped improve out services in this area and is being disseminated widely to the MEP Centers across the country.
We have developed several courses based on our experiences in this project.
We were surprised at how cheap some automated activities could be.
We developed some recommendations for successful implementations.
We developed recommendations for the Department of Defense (DoD) to encourage the spread of ABC among defense suppliers.
We developed a standard ABC model.

All reports and other information about this project are available on our World Wide Web Page - http://www.iti.org.

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2.0 Project Plan

The purpose of this project is to determine and quantify the costs and benefits of using Activity-Based Costing (ABC) in a small company environment to support an agile manufacturing strategy. The traditional costing method used by most small companies grouped all expenses, except direct labor and direct materials, in a pool and then allocated these expenses to products based on the number of direct labor or direct machine hours the product consumed. With the new technologies available to manufacturing enterprises, direct labor or machine hours were becoming a smaller component of product costs but were still being used to assign overhead costs. The result was that all products were being over or under costed as these companies did not understand the impact these new technologies had on their cost structure.

ABC offers a solution to this problem by assigning job costs based on the actual use of the firms resources, i.e., only those activity costs required to produce a product are assigned to the product cost. However, ABC is often only seen as a "big" company solution. Very few small companies have implemented ABC in conjunction with a shift toward agile manufacturing. This project is to demonstrate the potential of ABC in assisting small, agile manufacturers by implementing ABC in a sample of companies, measuring implementation costs, and quantifying the long term impact for the company.

2.1 Project Deliverables

1. *ABC implementation is six pilot small manufacturing firms.* These firms, three plastics parts processors and three machining firms, will be used as the basis for measuring the effectiveness of ABC in assisting companies in accurate job costing and estimating and improving their agility.
2. *A report quantifying the results of implementing ABC in small companies.* The report will present findings of the impact of ABC on sales dollars, profit margin, and estimating hit rate. It will also report on the cost to implement the ABC system, cost to maintain the system, company perceived value, job cost accuracy, and other measures of agility. The report will be broadly disseminated and will also be targeted at the firms participating in the Agile Manufacturing Pilot projects.
3. *Articles suitable for publication in scholarly journals and trade journals.* Utilizing the data collected from the six participating firms, the project team will develop articles for trade journals using a bottom line analysis for the ABC implementation, and for scholarly journals, a statistical analysis of the project.
4. *Customized ABC implementation templates for plastics parts and machining firms.* These templates will facilitate faster and cheaper ABC implementation in plastics and machining firms.
5. *Benchmarking Report.* A customized report comparing the performance of the six participating firms to the approximately six hundred firms in the MMTC Performance Benchmarking survey.

6. *A small company ABC implementation guidebook and a one-day Agility/ABC workshop* to present and explain the implementation process to interested companies. The implementation guidebook will provide an explanation of ABC concepts, steps to developing activity-based job costs, tips on creating personal computer spreadsheets to perform the ABC calculations, and guidelines on when additional outside expertise may be necessary. The guidebook and workshop will be focused on the firms participating in the Agile Manufacturing Pilot projects. Broader dissemination will take place through the NIST Manufacturing Extension Partnership.

2.2 Project Approach

The ABC model design and implementation was led by a well-known local ABC consultant, Douglas T. Hicks. Dr. Shannon Anderson and Dr. Bill Lanen of the University of Michigan School of Business Administration led the effort in measuring and analyzing the results. Dave Arnsdorf, Monica Fox, and Robert Erickson from ITI led the sales effort, provided overall project management, and assisted on the ABC model design and results measurement.

The project proceeded as follows:

1. **Recruit six small companies for the ABC.** We offered the projects to companies at 1/3 of the actual cost as an incentive for participating in the study. Three of the companies are plastics parts producers with the remaining three being machining companies.
2. **Take "as is" company measurements.** Examples of measures that were taken are sales dollars, profit margin, estimating hit rate, cost to implement system, cost to maintain system, kinds of jobs typically won or lost, company perceived value, and job cost accuracy.
3. **Implement ABC at each of the six companies.** This process involves interviewing all indirect and some direct labor as needed to determine what they do. In addition, we look at the expenses the company incurs. The expense data is typically taken from the general ledger. From the interviews and financial records, we then design an ABC model of the company and an estimating template. Both are built using spreadsheets.
4. **Provide support to the companies in interpreting and using the ABC data in running their companies.** In addition to product costing and customer quotations, we have instructed the participating companies on additional uses of their ABC model. Examples are capital equipment justification, overtime versus adding additional personnel, and incremental business analysis.
5. **Take "after" company measurements.** Using the same variables measured in Task 3 plus additional measures, gather after ABC data. In addition, measure the cost to do the ABC study and the ongoing costs to maintain and use the ABC system. This task is in process.
6. **Analyze results.** Analyze the differences in the "as is" and "after" measurements to determine significant improvements, significant cost increases, or any other

significant changes that can be used to determine the effectiveness of ABC in gathering accurate job costs. This task is in process.

7. Publish and disseminate results.

2.3 The Problem with Existing Costing Systems

The concept of agile manufacturing says that companies should become better able to respond to changes in the marketplace. In practice, this means that companies should make changes that increase their capability to make new, more difficult parts, make better quality parts (which often means in practice to make more consistent parts with tighter tolerance), make these parts faster than in the past, and make them for less money. Many companies in their quest to become more agile have replaced older manual machines with sophisticated computer controlled equipment. This new equipment is typically much faster, more accurate, and more capable than the manual equipment that it replaced. This change should have the effect of increasing the range of products and reducing the cost of these products. Thus, we would expect that companies that had made this change would show increased sales to wider segments of the market.

But in fact, that is not what we find at all. The far more common experience is that as companies modernize to become more agile, their market "window" becomes smaller. That is, the range of products that they make actually gets smaller. Many companies note that increasing overhead rates have forced them out of markets they previously were successful in. Others have struggled unsuccessfully at moving from low volume to high volume kinds of business.

Why does this occur? Virtually all small firms track costs by tracking direct labor and multiplying it by an overhead factor. Unfortunately, this kind of cost accounting system causes many problems and no longer gives a good approximation of their actual costs. Estimating is done using the data from cost accounting, so if the cost accounting data is inaccurate, the estimates will be also. In fact, a direct labor accounting system tends to skew costs in such a way as to effectively eliminate companies from large market segments that they should to be able to compete in based on the skills and capabilities of employees and equipment in the firm. We believe that the cause of this perverse effect is the structure of their cost accounting system. In ABC terms, these companies make two classical mistakes. They assume that all activities cost about the same per unit volume, and they assume that all costs are proportional to volume.

The combined effect of all these factors on an accounting system that attempts to capture all costs by tracking direct labor is to narrow the market window and make companies increasingly less agile as they modernize. Figure 2.4.1 below illustrates this effect. The top graph shows that any job has a mix of expensive and cheap activities, and that mix will vary. The second graph is a firm's cost structure before they modernize with new equipment. There are cheap activities and expensive activities but the difference between the cheapest and the most expensive is not that great. And, because all machines need operators at all times to operate, tracking direct labor hours gives a reasonable approximation of true costs.

The third graph shows the company after modernization. Now there are very large differences in cost between cheap activities and expensive activities. The result is that a company that still uses the direct labor method of estimating can only win jobs that do not use more than the average amount of cheap activities because they will over-price all jobs that use more than the average amount of cheap activities. They will win jobs that use more than average amounts of expensive activities, but because they are underpricing the job, they will loose money on it (but never understand why). If they win too many of these kinds of jobs, they will raise their overhead rate to compensate. Now they will win only jobs that use more than average amount of expensive resources. Conceptually, this is as if there was a small window over the graph. This window is the range of jobs that the company can both be competitive on and not loose money. Over time, that window will tend to drift toward the kinds of jobs that use more expensive resources.

This paradoxical result has some large ramifications. Companies are aware of this effect even though they may not understand the cause. Thus, many companies are reluctant to modernize equipment because they may have seen that the result of doing so is pricing themselves out of some markets and jeopardizing the health and existence of the firm.

2.4 The Solution

To support agile manufacturing, companies need to adopt Activity Based Costing. ABC systems should allow bids that more accurately reflect true costs. This should result in a wider range of products. In terms of Figure 2.4.1, instead of all jobs being estimated at the average cost, each job would have a different cost depending on what its mix of cheap and expensive resources were. The fourth graph in Figure 2.4.1 shows this solution - adopt ABC. With ABC, the profit margin is equal across the range of jobs, and the company can now win bids and make money on any project across the full range of activities that they do.

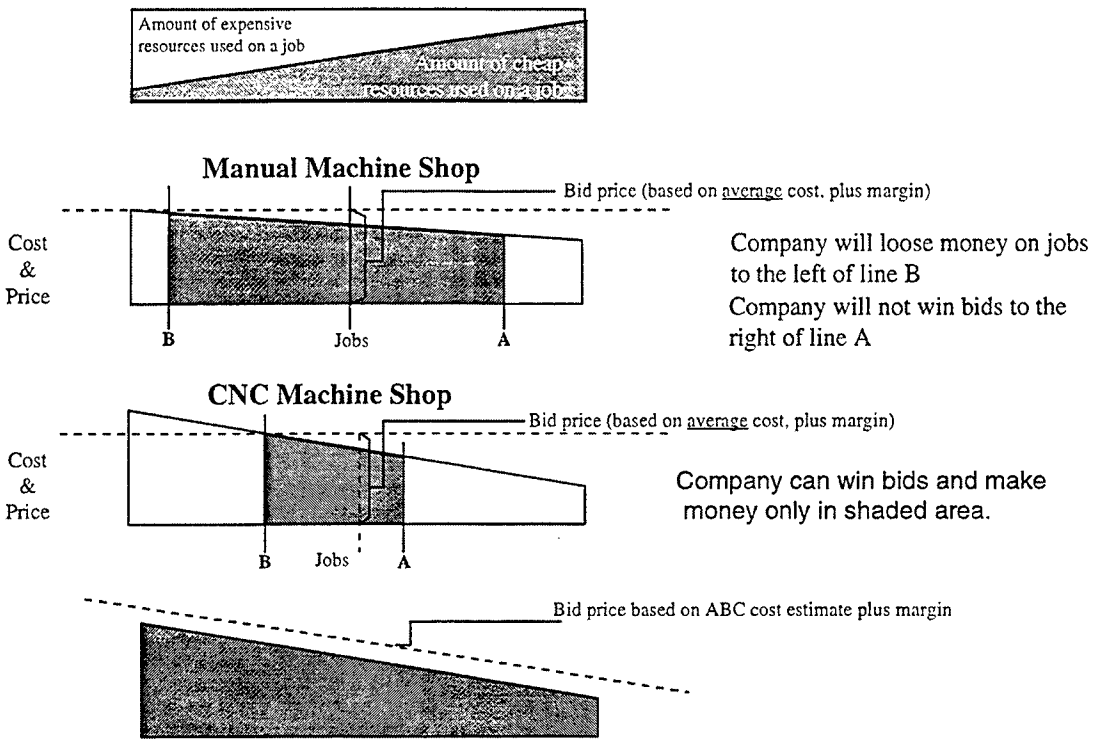


Figure 2.4.1 - The Agility Paradox

3.0 Standard ABC Model Format

The ABC system can be combined with the day-to-day accounting system, however, it is usually created as a separate cost model. This eliminates the need to maintain a complex accounting system to meet your decision-making needs and the requirements of GAAP (Generally Accepted Accounting Principles).

An ***Activity-Based Costing model:***

is a simplified replication of a company's true cost structure
identifies the main components of a company including:
- activities
- products/product lines
- customers/markets
- resources
- fixed and variable expenses

indicates how these components are interrelated. For example, it shows what activities are used to make a product/product line, how much of the activities are required, and what the activity costs. This information is then put together to come up with the cost per unit (batch) of the product.
is only valid with the range of assumptions used for creating the model. The model must reflect the current operating environment. It should be updated with existing activities and resources before using it for future business decisions. Do not use it if it contains old, outdated information and assumptions.

The following criteria should be considered before developing an ABC model for a company:

The intended use of the model - will it be used primarily for job quoting or will it be used to make many kinds of business decisions. If job quoting is the main goal, a simple spreadsheet that calculates cost rates may work as well as a more complex model. If what-if capability is required, a model that shows the relationship between several activities is necessary.
The complexity of the company's products and processes - if a company has many and varied products and processes, a "packaged" ABC program may be preferable to a spreadsheet or data base tool.
Resources available to maintain the ABC model - if, as in most small companies, resources are limited, keeping the model as simple as possible is important. Models can be simplified by creating fewer activity centers and fewer expense categories. While combining activities may sacrifice some accuracy, it is certainly preferable to not using ABC at all.
Data gathering technique - There are several different techniques, each with its own strengths and weaknesses. You will need to select the approach that best fits your needs for accuracy and timeliness.

The approach used in developing the model is not as important as the results. A useful ABC model accurately approximates the correct cost rather than precisely calculating the cost with

inaccurate detail. Following is a summary of the model used for the six case companies in this study.

3.1 Model approach

The first step in the ABC system creation is to determine the major results or needs that will be expected from the model. In other words, what are its intended uses? If a model is to be used primarily for job quotation, then some of the secondary activities can be consolidated into "higher" level activities that would shorten the implementation time and model complexity. Whereas, if the model has cost reduction or process improvement as its primary goal, then the model must reflect costs at all significant activities. This increases the cost and complexity of the model. Make sure that the management team is in accord with the expectations from the exercise before the project actually begins. This will help insure that the end product meets expectations.

The next step is to understand where are there unique complexities between manufacturing processes, between products, and between customers. The data gathering team needs to understand these complexities in order to capture data that can report and cost these differences. This information can best be identified through the use of a process flowchart. At the initial management meeting, the team is asked to flowchart a typical customer order from receipt to final shipment. Questions are asked by the facilitator at each activity regarding any areas that would differentiate this order from any other order passing through the activity.

Do not under estimate the amount of time and effort a company should devote to the development of their ABC model. One of the lessons learned in this project was that those companies who took an active role in the data collection and model building parts of the project were the companies who are making the most use of their ABC model. While outside help is needed to assist in the implementation of an ABC model, the company needs to make internal resources available to best understand the process and understand how to maintain it after the consultant has left.

The final step is determining how the data will be gathered. There are basically two approaches to data gathering: top down and bottom up.

> Top down - In this approach, the company management determines most, if not all, activities. In addition, they also decide the amount of the company resources that are consumed in each resource. Selected company employees may be interviewed to verify the information. The pros and cons of this method is that the data is gathered quickly, at lower internal cost and less employee disruption, but history has shown that the information can be suspect as management may not always understand employees' activities and the resources they consume.
>
> Bottom up- In this approach most, or all, employees are interviewed to determine the company activities and the amount of resources they consume. While the management team may assist in informing the implementation team of their perspective on the complexity issue, they do not assist in determining the activities of the company. Employees are interviewed as to what "work" they do, how much of their time is spent on each activity they do, and what physical resources do they use or consume. The pros and cons of this method is the opposite of the top down, data is more accurate, there is more

employee buy-in due to their involvement, but it takes significantly longer to gather the data and there will be work disruption as employees are being interviewed.

The approach used in developing the model is as important as the results. A useful ABC model accurately approximates the correct cost rather than precisely calculating the cost with inaccurate detail.

Our approach was to use an ABC model template using a standard spreadsheet package that could be adapted to each of the six companies. The model template was modularized to allow for easy expansion or simplification depending on the needs of the company.

The template modularity was based on fitting company activities into the following six categories:

Manufacturing activities - shop floor activities that are either machine or labor driven
Service and Support activities - typically office support activities such as quality control and accounting
Material Overhead activities - activities to support the purchase and handling of direct material such as purchasing, company owned transportation, internal storage and movement
Market Support activities - activities to support a particular customer or market segment
Product Support activities - activities to support a particular product type or category
Transaction/Event activities - recurring events that are done using internal company resources. Examples are customer order entry, manufacturing order preparation, sending parts to outside processing, and first piece inspections.

A standard set of activities cannot be created to fit all companies; however, most activities can be fitted into one of the above categories. The ABC model template contains the logic to appropriately collect and distribute costs depending on the category of activity being used. The user only needs to enter the activity names and the activity costs in the areas designated.

This approach allowed us flexibility in updating the model if we determined we had either too many, too few, or inappropriate activity centers designated. The logic was already incorporated in the model to allow us to easily change the names and cost distributions if products or processes were eliminated, added, or re-arranged.

3.2 Model Software

The models were built using standard spreadsheets, either Microsoft Excel or Lotus 1-2-3. We have found that this gave us the most flexibility and least expense. Using a spreadsheet format makes it easier to model the effects of large changes in business volume or other kinds of "what-if" issues.

We investigated the use of "packaged" ABC programs but decided not to use them for several reasons:

1. They were not designed to give the user "what-if" capability. It appeared that they were designed to give the activity center cost rates based on fixed activity center costs and cost drivers. Our spreadsheet model was designed to let the user enter cost driver

"multipliers" to generate costs that, in turn, generated the activity center cost rates. For example, electricity cost was entered as a "dollar per operating hour" for any machine driven activity center. As the planned operating hours go up, so does the Electricity cost. By contrast, the "packaged" ABC programs only allow the user to enter a fixed dollar amount of Electricity cost per activity center. The cost does not vary with operating hours and therefore severely limits the use of the ABC cost rates for making decisions outside the predefined range. Newer versions of software appear to be better at this than previous versions. We will be re-examining this issue in the coming months.

2. The relationship between activity centers, cost drivers, and cost rates is mostly hidden from the user. When using these programs, we felt as though we were just plugging in numbers without fully understanding how they were being used or how they affected the cost rates. With the spreadsheet model, the link between the cost rates and the activity centers can be easily traced to understand how the rates are developed and to determine if they make sense to the company. We felt the understanding and transparency of the logic was more important than the potentially slicker presentation offered by packaged software.
3. Cost. Commercial ABC packages can cost anywhere from a few hundred dollars to many thousands of dollars. Spreadsheets are very common and quite cheap.
4. Training requirements - Most people know how to use speadsheets. ABC software requires additional training to teach people how to use it.

3.3 Model Structure

The model structure we used is called a flow-down structure. A flow down model has multiple levels of activities. Some activities are consumed not by products or services by instead by other activities. We call these activities secondary activities. So, cost may flow from resources to secondary activities to primary activities or they flow directly to primary activities. Costs in secondary activities always flow to primary activities and then finally to products or services. Figure 3.3.1 shows this flow.

Most companies have two levels of activities; primary activities for which rates will be developed to calculate product costs and secondary activities that used or consumed by the primary activities. An example of a primary activity is a manufacturing cell where a product will get a charge from the cell based on how long it takes the cell to produce it. A secondary activity would be maintenance that needs to support the machines in the cell and keep them running.

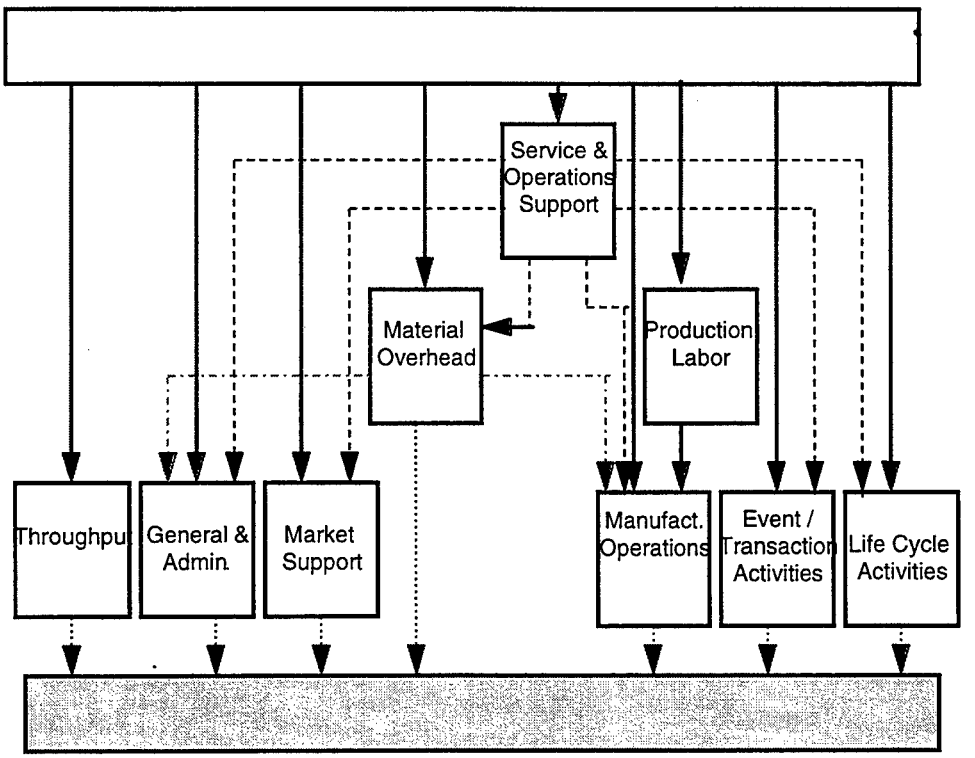


Figure 3.3.1

Each model is different in detail from other models. This difference reflects the differences in equipment, manufacturing approach, markets, and strategy of each of the companies. However, there are some common elements of all the models. The model is a series of tables that summarize findings and calculate various statistics used in developing the activity costs. The basic structure of the model and typical tables that are used in all the models are shown below.

Typical Tables in the ABC model include:

Activity dictionary - this is a list of all the activities used in the model, the corresponding activity driver, and a description of the activity.

Expense Summary - These tables show how general ledger cost (all general ledger costs except for labor) is distributed to initial cost pools or activity centers.

Personnel Allocation - This is a table showing how personnel allocate their time to the activities.

Personnel costs - These are a series of tables that calculate total personnel costs by adding fringe benefit costs such as holidays, medical insurance, vacation, and sick time to the basic hourly personnel costs for various categories of personnel. This table is also typically used to calculate the number of hours available to work.

Flow-down Distributions - This is a table showing how the secondary activities' costs are distributed to the primary activities.

The cost accumulation schedule is a summary of all costs in each primary activity.

The activity rate schedule is used to calculate the cost for each activity per its cost driver.

The cost roll-up table is used to check the calculations. The activity rates are multiplied by the volume of drivers to get total costs. These are summed and should equal total costs for the time period that this model covered. (If they don't, then there was a mistake make in the math and we go back and fix it.)

The model template is divided into 5 sections; each with a series of tables that collect or distribute costs to the primary and secondary activity centers. The structure of the model, tables, and data is as follows.

Section 1: Resource Requirements

The first section of the model sets the resource requirements for the "level of business" the company expects. Tables in this section identify:

Activity centers along with their operating hours and cost drivers
Purchased material costs
Square footage by activity center
Machines and capacity by activity center

Section 2: Cost Accumulation

These tables in this section identify and accumulate all costs by activity center. Tables of these costs include:

Personnel expenses including hourly and salary employees
Fringe benefits
Fixed costs such as depreciation, property taxes, leases, and other budgeted expenses
Variable costs such as utilities, shop and office supplies, and worker's compensation

Section 3: Support Activities Distribution

Once all expenses have been accumulated for the support activities, their costs are distributed to the primary activities. The distribution is done through estimated percentages of the primary activity's use of each support activity. For example, if CNC programming is included in the Engineering Support Activity, Engineering costs will be proportionately assigned to any primary manufacturing activity that requires use of the CNC programming capability.

Section 4: Cost Rate Calculation

At this point in the model, all costs have been accumulated in the primary activities. Rates are calculated by dividing the total costs for each activity by the amount of the cost driver identified in Section 1. For example, if a manufacturing activity accumulated $100,000 in cost, had machine hours as its cost driver, and expected to have 1000 operating hours, its cost per machine hour would be $100.

Section 5: Product Costing or Quoting Template

The Estimating Template identifies a product's use of each of the primary activities and calculates the product cost by multiplying the usage by the cost rates calculated earlier. For example, if Setup is a primary activity and the cost driver is number of setups, the estimator would need to enter his estimate of how many setups the new product required. If the driver was set-up hours, then the estimator would need to estimate the number of setup hours required.

3.4 Typical Activities

Although each model starts with the same template, the details of each can be very different. Such differences can include support activities, material overhead structure and cost drivers, market versus product support, and cellular versus functional manufacturing flow.

These are examples of typical activities and their drivers. The secondary activities are more likely to stay the same from company to company than the primary activities.

Primary: (Typical Examples)	**Drivers:**
CNC Machines	Machine Hours
Manual Grinding	Labor Hours
Final Inspection	No. of Parts or Inspections
Machine Set-up	Setup Hours
Assembly	Labor Hours
Shipping	No. of Shipments or Line Items
150 Ton Press	Machine Hours
Material Overhead	Material cost, weight, or No. of orders
Welding	No. of Welds
Product Design	Design hours
Order Entry	No. of orders
Injection Molding	Machine Hours
Market Support	% of conversion costs

Secondary: (Typical Examples)	**Drivers:**
Human Resource	No. of Employees
Building Maintenance	Square Footage
Engineering	Estimated percent usage
Quality Control	Estimated percent usage
Material Handling	Estimated percent usage
Sales	Estimated percent usage
General Administration	% of Internal Costs
Accounting	Estimated percent usage
Manufacturing Supervision	No. of Shop Employees

3.5 Model Design Issues

An ABC model is a stand alone management tool that does not have to adhere to GAAP regulations, therefore it can open up a wide range of issues that need to be discussed during the system design stage.

One of the first issues to be addressed is how to account for the present cost of long life assets such as machines. Traditional financial accounting uses historical cost as the basis for this and calculates depreciation cost. But there are several problems with depreciation. First, many firms use some accelerated depreciation. While tax law allows this, it does not make sense to use in a costing model. Second, tax law again usually sets the length of depreciation. This length may be more or less than the true expected life. Since this is a management tool, the value on the accounting records does not need to be used in the model. So, if historical cost is used, we take the initial cost and spread it evenly over our best estimate of the life of the machine.

But what do you do if the equipment is already fully depreciated or the technology is rapidly changing? There are two other ways of calculating costs – market value and replacement cost. Market value is the amount of money you could get if you sold the equipment today. We assume that the company is borrowing that amount of money and then spread that cost evenly over the expected life of the machine. In replacement cost analysis, we assume any spent costs are gone and instead ask when will we need to replace our current machinery and how much will it cost. Then we need to make enough each year so that when we get to replacement time we have the money to buy the new equipment.

The value used in the model for equipment and buildings can be replacement value, current market value, or forecasted future replacement value. Any one of these values will change the cost assigned to each activity. Note also that there are many values used in this calculation that are, at best only, rough estimates such as the present market value of equipment, the future cost of replacement equipment, the remaining lifespan of existing equipment, and interest rates. All these different estimates along with estimates of future use mean that no ABC model can be more that a rough estimate of true costs.

Another issue is whether to use prior years' actual utilization, current year's forecast, or practical capacity when calculating the cost of machines. We discourage the use of historical data for anything but for analysis of model integrity. Forecast data, which should reflect the time period the model is in use, should be used in the development of the final model. An interesting argument can be made that all models should be built using the practical capacity of the company, not what they forecast for the coming period. This philosophy states that a product should not be forced to carry the cost of excess capacity. Practical capacity is defined as the production level that can be achieved with the current staff, work hour structure, and equipment. In other words, if a production activity has the capacity to produce more product with the current assets, but the sales forecast is lower than that amount, the ABC model should use the higher capacity values. If the expected actual production level is used, the result is higher costs as the fixed costs are being allocated over a lower volume. If the cost was based on a practical capacity volume, perhaps more products could be sold, as the cost per unit would be less.

All of these approaches are valid. The key is to remember that a useful ABC model accurately approximates the correct cost rather than precisely calculating the cost with inaccurate detail.

Most companies are quite limited in their understanding of cost issues. Thus, there is a lot they need to learn to begin to understand what an ABC model is and how to use the information included in it. Because of this learning required, we preferred to spread the ABC model building effort out to at least 3 months. There is a lot of new information to discover and understand in this process for the companies. Small companies also are usually quite thin in the management ranks. It is common to find a company where top executives are spending at least part of the day helping with some aspect of production. We have found that they do better if we allow them more time to assimilate the new concepts and data.

While a key concept in ABC is to create more detailed breakdowns of costs, there is a limit to how much detail can be modeled. Beyond some limit, more detail obscures reality instead of illuminating it. Many short-term fluctuations should be ignored. For example, it is often difficult to determine how much maintenance a particular product used. And in fact, we do not want to determine this in too much detail. Just because a machine breaks while a particular product is using it does not mean that we would want to charge all that cost to that product. A better approach is to take a relatively long period of time and average the cost of maintenance for the machine over that time. Then any product that uses that machine will get a proportionate share of the maintenance costs. If there are some products that are likely to cause more wear on the machine than others, we might weight the distribution of maintenance costs to the machine to account for that. The result is that in the machine cost is a cost for maintenance. The key concept here is that we are more interested in long term averages and not extraordinary events.

For some issues, there is no "best" approach. Each approach has limitations. For example, a design issue for Modern Machining was how to lump the different machine tools into activity centers. MM has an assortment of CNC lathes that are not quite equal in capabilities or costs. We were not sure if each of these should be a separate activity or should they be lumped together. The costs for operating each of these lathes are not equal, although they are not too different. Their capabilities are not equal although there is a lot of overlap in what they can do. If we make them different activities we run the risk that only the most capable, inexpensive activity will ever be planned and estimated. We saw a case like this once where the cheapest machine was oversold 300% while other machines were unused. Of course, what happened was that the cheapest, most capable machine was used first, then the next cheapest, and so on. The company ended up going bankrupt because they had to move production to the more expensive machines to get it done, and lost money on many jobs. On the other hand, if we lump them all together, we average the costs among them. Jobs that would use the cheapest equipment are now penalized. Jobs that will use the most expensive equipment are subsidized. So, it we are not careful, we will only get jobs that use the most expensive equipment. In this case, we decided to make several different activities for the CNC lathes, but warn the company of the potential danger of selling only the cheapest capability.

In general, we want to try to keep the model as simple as possible. Part of the way we do this is to use the concept of materiality. This says that only those issues that would make a significant difference in the results should be modeled. This also allows us to use drivers that may only be approximately correct. While we want the model to be complete, we need to recognize that it is approximate, that there are limits to how accurate we can be, and that too much complexity hinders understanding and use.

The model is valid over the range of input resources that are available. This means that you cannot do more work than you have resources available for. The range can be extended by considering how the company would change as resources were added and then adding resources to appropriate parts of the model. For example, if your company doubles in sales, you will need to add production workers, but you will not add another president.

3.6 Model Design Summary

The model will be used extensively to estimate product costs and make decisions about the future direction of the company. It is critical that the model contains ***future*** expected costs and operating levels for the output to be accurate. Even though the model may be developed using past data, once the company is confident that the links between costs and activities are correct, all past data should be replaced with future resource requirements and expenses.

3.7 Model Examples

Example Quoting Sheet

Customer:	Ajax Machine
Part:	1234-678
Quantity:	500
Quote Number	97-0005

Activities	Driver	Activity Cost	Frequency	Extended Cost
Machine				
Tarus	Machine Hours	$75.13		$0.00
Cincinnati Mill	Machine Hours	$61.45	2	$122.91
Lg. Fadel/Sharrnoa	Machine Hours	$44.44	6.5	$288.84
Sm. Fadel/Sharrnoa	Machine Hours	$32.59		$0.00
Sm. CNC	Machine Hours	$23.05	12	$276.57
EDM	Machine Hours	$54.30	45	$2,443.29
Manual				
Benching	Labor Hours	$41.08	35	$1,437.85
Manual Mach	Labor Hours	$43.29	12	$519.44
Assembly	Labor Hours	$41.19	6	$247.13
Tryout	Labor Hours	$33.96	1	$33.96
Weld/Spot	Labor Hours	$45.30	2.5	$113.24
CMM	Labor Hours	$44.52	4	$178.10
Shipping	No. Shipments	$40.76	1	$40.76
Engineering				
CAD/CAM	No. Hrs.	$38.04	30	$1,141.24
Design	No. Hrs.	$51.68	15	$775.13
Estimating	No. Quotes	$33.07	2	$66.14
Sales	No. Customer Orders	$578.85	1	$578.85
Material				
Steel		1000	$4.50	$4,500.00
				$0.00
				$0.00
Outside Processing				
Heat Treat		500	2	$1,000.00
Tryouts		10	160	$1,600.00
				$0.00
				$0.00
Total matl & O.S. Proc				$7,100.00
Material Overhead	$ of purchases	14.84%		$1,053.72
Total Cost				$16,417.18
Unit Cost				$32.83

Example ABC Model - Lotsa Cost – See the Lotsa Cost model attached at the end of this report.

4.0 The Process of Gathering Data and Designing the ABC Model

Following is a summary of the process used to develop the ABC models for the six case companies:

1. Provide an introductory seminar on ABC to the company.

The purpose of this seminar is to provide an overview of Activity-Based Costing, its uses, and potential benefits. We also explain the steps we will take in developing the model and what information we will be gathering from those involved. Attendees of the seminar should include both operations and financial employees. All personnel to be interviewed should also attend this seminar so the concept and the process do not have to be re-explained at every interview.

2. Identify and define relevant activities.

Activities are the basis of the model because they are easily identified and understood. Activities highlight the root causes of cost which leads to cost reduction plans. A successful ABC model requires selecting the most appropriate activities. If too many lower-level activities are included, the model will become too complicated. If only top-level activities are considered, the model will hide crucial cost differences between jobs just as the "plant-wide overhead rate" does.

Activity data is primarily gathered through interviews, both with groups and individuals. Immediately following the introductory seminar, the interviewers take a plant tour and hold group interview with several key personnel. The key personnel are asked to give an overview of all manufacturing and support activities. This initial data gathering interview provides direction for more detailed questioning with department representatives and key personnel.

Interviewing can also be done top down or bottom up. If you interview just management, you are doing top down interviewing. Our experience is that management often has at best a hazy grasp on how employees are actually spending their time. So, we interview all indirect people and at least a sample of direct personnel. Some companies have good records of what direct personnel do, but some do not. If the time card records are not adequate for our needs, we interview all the direct personnel as well.

Typically, two interviewers gather the remaining ABC data. One concentrates on identifying manufacturing and support activities while the other focuses on accounting functions and gathering cost data for the activity centers. This approach seemed to work well, as it required that only one person become familiar with the general ledger and accounting practices.

3. Organize activities by activity center

Organize the identified activities into *Activity Centers*. An *Activity Center* is a group of related activities (processes or procedures) that have a similar cost profile and will have a common cost driver. Activities could also be grouped together because the same group of people performs the activities or they are used by the products in the same way. Following is a table that provides some guidelines for grouping activities.

Activity Identification and Grouping
Table 4.3.1

Support Activities	Manufacturing Activities	Material Overhead Pools	Transaction/ Event Pools	Customer/ Market Pools	Product Pools
Create a support activity when:	Create a manufacturing activity center when:	Create a Mat'l Overhead Category when:	Create a Trans./Event Pool when:	Create a customers cost pool when:	Create a product pool whe
	There are differences in:	There are differences in:	An activity:	There are differences in:	There ar differenc in:
1. Significant cost/personnel	1. Cost profile of the mfg. process	1. Mat'l overhead activities	1. is repeatable	1. Quote cycle time	1. Contr length
2.Cost can be tied to product, customer, or other activity center	2. Manning, such as the number of operators per machine	2. Part size/storage requirements	2. is measurable	2. Quote frequency	2. Enginee content; black bo vs. build print
	3. Wage rates	3. Part weight	3. incurs significant cost	3. Sales hrs per sales dollar	3. Produ volumes
	4. Machine capability	4. Order frequency	4. used in differing amounts by other activities, products or customers	4. Service level or expectations	4. Sched stability
	5. Machine vs. labor driven	5. Blanket vs. discrete PO		5. Quality expectations	5. Enginee change frequenc
		6. Material Cost			
		7. Material Scarcity			

4. Identify major elements of cost.

Identify and group all company costs into the following categories:

Throughput Costs: costs that vary directly with the organization's throughput, such as volume of product. Examples of costs in this category are direct materials, purchased

components, and outside processing. These costs are typically the easiest to identify as part of a particular product or job.

Salaries and Wages: payroll costs including time paid for breaks and holidays

Purchased Fringe Benefits: includes health insurance, pensions, employee assistance programs

Miscellaneous Costs: all direct operating costs not included as salaries and wages or purchased fringe benefits. These costs will be assigned to specific activity centers using cost drivers. Costs in this category include:

- utilities
- depreciation
- property taxes
- supplies

5. Determine the relationship between activities and costs.

In this step, non-labor costs, primarily from the general ledger, and payroll costs are assigned to the appropriate Activity Center using cost drivers. The first step is to create cost pools. The next step is to determine the cost drivers or the way in which the costs are distributed to activities and cost objects.

Throughput costs are distributed directly to products or jobs

Salaries, wages and purchased fringe benefits go with the personnel assigned to each Activity Center

Miscellaneous costs are assigned either directly to an Activity Center, as is the case with special tooling that may only be used on one machine or Activity Center, or by using a cost driver. For example, utilities may be charged to Activity Centers based on the number of machine hours, or property taxes may be distributed based on an Activity Center's square footage.

6. Identify activity drivers to assign costs to products.

Distribute Activity Center costs and throughput costs to the products or cost objectives using activity drivers. Activity drivers indicate where to charge costs and often provide part of the formula for determining how much that cost should be. Activity drivers are determined through the interviewing process and understanding how people and activities are linked to products. Typical activity drivers include:

Labor drivers
- labor dollars
- labor hours
- headcount

Operating time
- machine hours
- set-up hours

Occupancy: square footage occupied

Throughput
- pieces

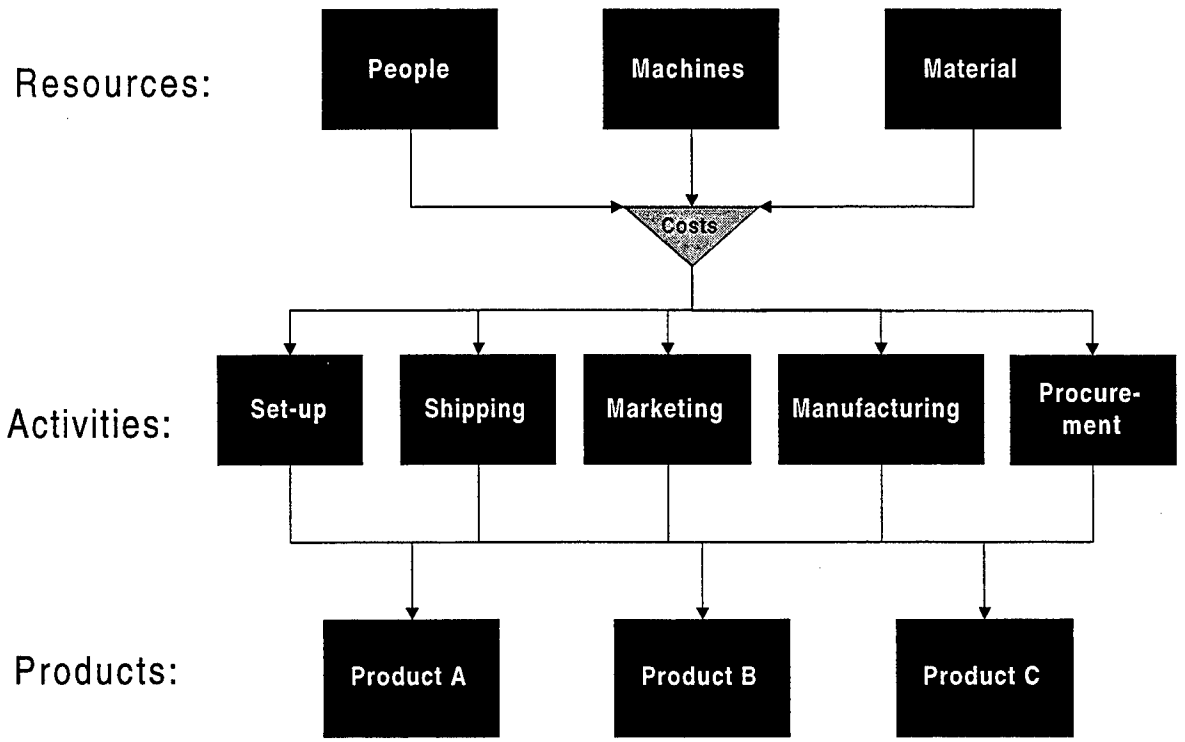
pounds
gallons
feet

Demand: measured and estimated usage. Typically, support staff costs are distributed to manufacturing activities, material overhead pools, event pools, and customer or product support pools based on estimated demand. For example, the cost for a sales activity center may be distributed to various customers depending on the level of support each customer requires.

Surrogate drivers: used in place of a more accurate cost driver that may be too difficult to measure

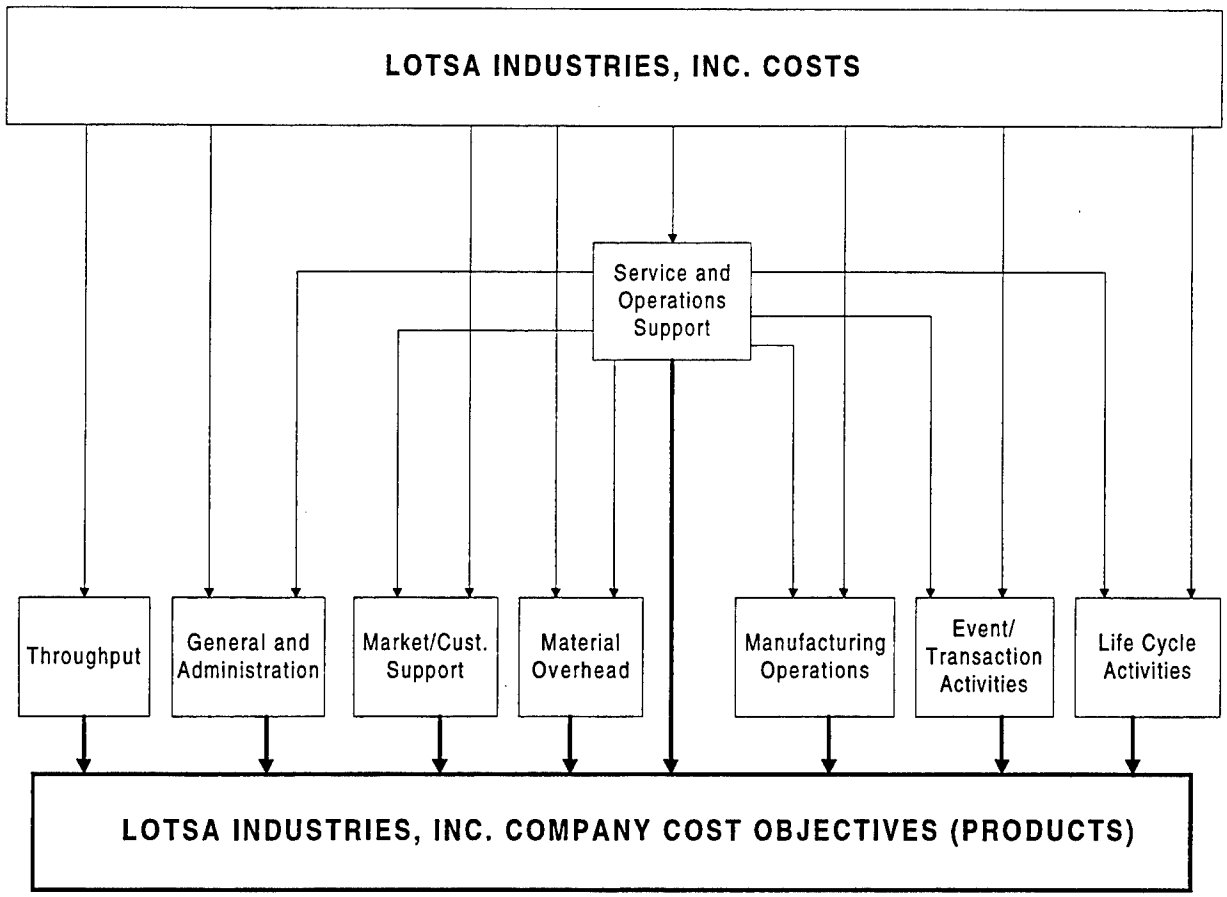
conversion costs or value added
outside processing costs
product/service characteristics
material costs

ACTIVITY-BASED COSTING:
Activities Consume Resources



7. Establish the cost-flow pattern and model design

The cost-flow pattern puts together all the activity information, cost elements and cost drivers. It identifies what costs are incurred, where they are incurred and how they are consumed by the company's products or cost objectives. Following is a diagram showing how costs "flow" first into the Activity Centers of Lotsa Industries and then to the products.



8. Review the findings with the company

The model design, including the activity centers and cost drivers, are reviewed with the company representatives to ensure that the completed model will accurately reflect the companies activities and their link to producing the company's products.

9. Gather the necessary data to drive the ABC model

Gather data and enter it into the model. The models are built using the actual costs from a previous period to ensure that all company costs are accounted for in the model structure. Gathering the data involves looking in several places and often, particularly for first time models, estimating percentages of costs that belong to various activities. Typical places to find data are:

Income statement
Timesheets
Routings
Personnel records
Purchase orders
Employee interviews
Plant layout
Equipment listing

General Ledger
Ledger
Supplies
Transportation
Tooling

This step also involves determining *how much* each product uses of each Activity Center costs. The cost for each product is calculated as follows:

Unit Product Cost = Units of each Activity Center Used * Activity Center Rate

10. Review the model results, make adjustments, and develop company cost rates

Carefully review the results of the model to insure that they make sense. If not, the cost-flow pattern and/or the data should be reviewed for accuracy. Cost rates are reviewed by showing what percent of costs have been assigned to each activity center. For example, we review the percentage of total direct labor dollars charged to each manufacturing activity center to ensure that they look reasonable based on the number of direct labor personnel assigned there. The model should be reviewed and compared to the actual company on a periodic basis (probably no more than a year) so the model continues to reflect what is actually happening in the company.

11. Load budget data for the forthcoming year into the model

Previous time period data should be replaced with current year budget data so it can be used as a decision making tool for current business conditions. This process is done with the client as part of the model training. The completed model, along with explanations of each schedule, is presented to the client ready to use.

12. Help the company update and modify the model as required to reflect business strategy changes

5.0 Uses of the ABC Model

5.1 Introduction

There are many ways to use an ABC model, including:

Estimating
Capital equipment justification
Guidance in selecting areas needing improvement (CI guidance)
Pricing incremental business
Pricing very large orders
Make/buy decisions

In all cases you need to ensure that the model is still valid for the case considered - i.e. the range of alternatives still fits in the range of assumptions used to build the model. This means that the resource requirements that you used to build the model are not exceeded and the activities and drivers have not changed.

ABC is most often thought of as a better way to create job quotes. But the ABC model can provide valuable information not only for job quotations, but also to help with many other critical decisions. To do this, data in the model is changed to simulate a situation and then the model results are compared with the base model. Care should be taken not to update the model for every job quoted, but rather only when the change affects the underlying assumptions of the model or significantly impacts the overall "cost structure" of the company. The base model should be set to reflect the "typical" operating level of the company where products representing the "core" business of the company will come and go throughout the course of the period being modeled.

When changes to the model are required, as shown below, comparisons of the new model and the base model can be made on overall company costs or the costs for a particular activity center or product. Some typical situations that can be simulated with the model are described below.

5.2 Should you accept a short-term job that is not part of your core business?

Resources required to produce a short-term job, such as overtime, utilities, supplies, and materials are entered into the model. The model results are then used to determine if the revenue from the job will be greater than the incremental costs. Incremental jobs can often benefit a company if the following criteria are kept in mind:

This method should *only* be used for "*non-core*" business, or special, one-time orders, typically with companies that are not your usual customers.
These jobs can help maintain company profits during slow periods
Accepting incremental jobs should *only* be done if *excess capacity exists*

Steps to take in using the model to make such a decision would include:

1. Update company resource requirements to reflect any additional materials, machine hours, order processing, and setup requirements for the new job
2. Review machine capacity to determine if capacity limits are exceeded with the additional machine hours required.
3. Add any additional direct or indirect personnel that may be required to produce the new job
4. Add any fixed cost increases such as transportation, equipment leases, legal fees, professional development, etc.
5. Change any variable expense multipliers to allow for increases in utility consumption or supplies consumption. Variable expense multipliers will probably not need to be altered if they are already tied to hours of operation or headcounts that have already been adjusted.
6. Compare the total company costs for the original model and the one that includes the new job. If total additional costs are less than the anticipated income from the new job, then it may benefit the company.

If in the longer term the job is being considered as a part of the company's regular products, it should be quoted using the ABC quoting template which includes *all* company costs, not just the incremental costs caused by this job. Pricing based on incremental costs should be used very cautiously because it can cause great damage to your regular market if used incorrectly.

5.3 What is the anticipated Return on Investment for a proposed capital equipment purchase?

Calculating Return on Investment (ROI) can be done for equipment changes to an existing activity center by modifying its capacity, labor requirements, depreciation, supplies, utilities, and maintenance requirements. ROI can also be calculated for the addition of equipment and an activity center by adding it and its resource requirements to the model. The revised models can be compared to the base model to determine the cost savings or payback for a proposed capital equipment purchase.

Steps to take in using the model to make such a decision include:

1. Reduce or increase the total direct labor, if needed, for the Activity Center affected by the equipment change.
2. Reduce or increase the number of operators required to run the new equipment.
3. Adjust the amount of support personnel required to maintain the new equipment.
4. Adjust the Equipment Depreciation Expense for the Activity Center to reflect the cost of the new equipment.
5. Adjust the Utilities and Supplies Multipliers for the Activity Center to reflect any increases or decreases in consumption due to the new equipment.

6. Compare the total company costs for the original model and the one that includes the new equipment. Use the difference in costs for the two models to calculate the payback and/or Return on Investment for the purchase of the new equipment.

5.4 Should an in-house job be outsourced?

Many times companies decide to outsource work on the basis of a part's "fully loaded" cost versus that of a supplier. The in-house cost includes an overhead cost, usually some percentage of labor cost, and the assumption is made that if the labor is eliminated, the associated overhead costs will be eliminated too.

Evaluating the profitability of outsourcing products can be done in two ways depending on whether or not the company plans to replace the outsourced business with other work. Following are summaries of what to do and what to look for in each of these instances.

Scenario A- Outsourced Business is Not Replaced

Steps to update the model when outsourced business will not be replaced are similar to those outlined for deciding whether or not to accept a short-term job except in this instance, resources and expenses will be reduced, not added. When finished, the ABC model will show that total company costs have decreased (the company has "shrunk") but so will total company revenue. The total difference between revenue and costs should be reviewed to determine if costs shrunk at a greater rate than revenue.

Another important consideration when outsourcing business that will not be replaced is the effect the change will have on the "fully loaded" costs of the company's other products. Usually the outsourcing of one or two products will not significantly reduce the company's fixed or semi-fixed costs so it may mean a higher proportion of those fixed costs are now distributed to the products that remain. The company should carefully review these effects to determine if the "smaller" company will be able to cover the potentially higher costs in its current profit margin or be able to charge customers a higher price. Many companies have started the death spiral of lower volume, higher costs by not carefully considering the effect of outsourcing on their overall business.

Scenario B - Outsourced Business will be Replaced

The ABC model should be updated by making changes that reflect the difference in resources and expenses required by the outsourced work and the replacement business. Before and after models should be compared for differences in overall costs as well as any differences to individual activity center rates. Again if total costs are proportionally less than the additional revenue, the new business may be more profitable.

If both the outsourced and the replacement business fall within the parameters used to create the base model, no changes are required and the base model quoting template can be used to evaluate the profitability of the replacement work.

5.5 What product mix offers the greatest return?

The ABC model can be used to simulate various product mixes by changing product volumes and resource requirements in the model. This information can be helpful in planning sales and pricing strategies to maximize return with your current resources. Possible areas in the model where resources and expenses may need to be manipulated include:

Direct material throughput costs
Activity center operating hours or other cost driver bases
Labor types and rates
Operating supplies, utilities, or budgeted expenses
Support staff and activity center levels

Different products usually require varying amounts of a company's resources and activities. Running several versions of the model will help identify the product mix that best fits the company's structure and goals.

5.6 Will a long-term contract for a product be profitable over the life of the contract? At what point will development expenses be recovered? How will customer price reductions affect profitability?

Most often an ABC model is designed to fit the profile or structure of a company over a limited period of time, usually one year. The model is updated with new activities and expenses at the beginning of a new modeling period. The trend for many companies is to enter into long term contracts with suppliers that sometimes include scheduled price reductions. In this situation, a single year model may not accurately reflect the profitability of a job over several years. A better approach is to generate an ABC model for each year of the contract taking into account the changes in economics from year to year. Changes to incorporate from year to year include:

levels of business reflected in throughput costs and operating hours
planned additions, replacement of manufacturing capability
market or customer focus including changes to product mix
labor rate increases or decreases especially if they are part of a formal agreement as with a union contract
increased expenses such as benefits, utilities or supplies

Multiple models will allow a company to assess not only the product cost and customer prices by year, but also include and "upfront" development costs such as engineering that may have taken place at the beginning of a contract. This multiple year comparison will look at the total costs and revenues expected over the length of the contract to determine year by year cash flow and total profit for the job.

5.7 What is the impact of continuous improvement projects on the company's profitability?

In the past several years, many companies have launched continuous improvement initiatives to both improve their competitiveness and to satisfy the requirements of ISO 9000 and QS 9000. An ABC model is a great tool for both identifying where a company may be able to achieve the greatest benefit of continuous improvement activities and tracking the results of improvements that have already been implemented.

Identifying Potential Improvement Projects

The base ABC model identifies potential areas for improvement by identifying those areas and activities that incur the greatest amount of expense. For example, if the company is performing first piece approvals at every operation, the costs in the "inspection" pool will represent a large portion not only of quality related expenses, but also of total support costs. Therefore, a potential improvement project would be to reduce first piece approvals, resulting in reduced inspection costs. In general terms, if you can reduce the level of an activity, you can reduce the expenses associated with that activity. Changing the model to reflect the improvements and comparing the total costs of the new model with the base model can test the potential impact of an improvement. Changes required to the model depend on the type of improvement, although most will be similar to the ones discussed earlier in this section.

Tracking the Results of an Improvement

Once an improvement has been implemented, the base model can be updated to reflect the changes. This will give the expected costs for each activity center that can be compared to actual performance. Actual costs will be easier to compare to the model if the departments and categories used to collect actual costs are easily mapped to the activity centers in the ABC model.

5.8 Summary

The ABC model is used to look at the overall company performance as well as individual activity centers or products when making decisions. It takes into consideration the interrelationships of products, activities and customers when determining the impact of changes and improvements.

6.0 Company Cases Review

The company names used in this report are not the actual names of the companies.

6.1 Modern Machining Case Study

Company background and goals

Modern Machining (MM) makes jet engine parts for the commercial and defense industry. 95% of their sales are to one large jet engine maker. About half of their parts are for defense applications, although they often do not know which parts will be used in defense applications and which will be used in civilian applications because the same engines are used both places. Aerospace work has been down in the last few years, and so Modern machining has been looking for work in other areas. Their expertise is in large turned parts with secondary milling and grinding operations, and made from exotic alloys. These skills and capacities are not all that common, and demand for them is limited, but there is demand. One good potential area is locomotive engine parts. MM has been able to get some limited work in this area, but only for short runs when cost was not a major consideration. MM has generally been too expensive to get large standard orders.

MM believed that a number of functions such as manufacturing engineering and quality that were used heavily by aerospace products would be used lightly or not at all by non-aerospace products. The hope was that ABC would allow MM to not charge jobs for functions in the plant that were not used and thus reduce the overall price and get more work.

MM had also implemented a machining cell a few months earlier. The cell was quite successful. It has allowed them to significantly reduce throughput time and work in process inventory. While MM thinks that this is a cheaper way to do machining, they are not sure. So, the other goal for the ABC implementation was to measure the cost of the cell.

MM also has a job shop scheduling system that allows them to enter a cost for each activity defined to the system. The system will then calculate costs based on times spent on each activity. They wanted to take the activity costs calculated in the ABC model and enter them into the scheduling system. Their goal is to have it value inventory.

ABC model design process and issues

The process we used is typical, and is the standard one we use for all ABC jobs. We started by giving an overview of ABC to all management employees and a sample of non-management employees. Next we began two parallel efforts. In order to define activities and begin to understand what costs flow into these activities, one person interviewed all indirect personnel and direct personnel whose actual tasks were not clear. Another person began to collect costs. This effort involves a study of the accounting data to see how much detail on costs is available and to begin to sort it into categories that fit the activity definitions. The general ledger data was the most useful data for this gathering this information.

When we had what we felt was a good definition of activities and cost drivers, we presented this information to the company. This meeting took all day. We explained our reasoning in defining the activities as we did and solicited feedback. Based on that feedback, we made a number of changes and clarifications.

Next, we created the ABC model in a spreadsheet format. We completed gathering the data on costs and cost drivers. We loaded last year's actual information into the model to test it. Total costs must be spread to individual jobs correctly and the sum of the costs of all the jobs must equal the total costs input. After checking the results, we loaded the budget information for the coming year into the model.

We then held another session with the company management where we presented the results and discussed their meaning. We also presented an estimating template that used the same activity definitions and activity costs. This template was also built in a spreadsheet.

We prefer to spread the ABC model building effort out to at least 3 months. There is a lot of new information to discover and understand in this process for the companies. Small companies also are usually quite thin in the management ranks. It is common to find a company where top executives are spending at least part of the day helping with some aspect of production. We have found that they do better if we allow them more time to assimilate the new concepts and data. In the case of MM, it took us about 5 months to complete the process. The additional delays were due to time limitations on their part.

There are many ways to build an ABC cost model. In general, the structure (as shown in figure 3) is to have costs (or cost elements) that are distributed to activities in proportion to how much each activity uses that cost. Activity costs are then distributed to projects or products based on how much of each activity is used by each product. Cost drivers are used to calculate the distributions at both levels.

In the models we use, we typically use two "levels" of activities. The primary level activities are consumed directly by the products. The secondary level activities are consumed by the primary level activities. For example, it is difficult to determine how much maintenance a particular product used. Nor do we even want to determine this. Just because a machine breaks while a particular product is using it does not mean that we would want to charge all that cost to that product. A better approach is to take a relatively long period of time, average the cost of maintenance for the machine over that time. Then any product that uses that machine will get a proportionate share of the maintenance costs. If there are some products that are likely to cause more wear on the machine than others, we might weight the distribution of maintenance costs to the machine to account for that. The result is that in the machine cost is a cost for maintenance.

We use the maintenance activity to gather all costs associated with maintenance and then distribute them to other activities based on those activities' use of maintenance. We have found this two level activity model to be much easier to work with and easier to understand.

Another design issue was how to lump the different machine tools into activity centers. MM has an assortment of CNC lathes that are not quite equal in capabilities or costs. We were not sure if each of these be a separate activity or should they be lumped together.

The costs for operating each of these lathes are not equal, although they are not too different. Their capabilities are not equal although there is a lot of overlap in what they can do. If we make them different activities we run the risk that only the most capable, inexpensive activity will ever be planned and estimated.

We saw a case like this once where the cheapest machine was oversold 300% while other machines were unused. Of course, what happened was that the cheapest, most capable machine was used first, then the next cheapest, and so on. The company ended up going bankrupt because they had to move production to the more expensive machines to get it done, and lost money on many jobs.

On the other hand, if we lump them all together, we average the costs among them. Jobs that would use the cheapest equipment are now penalized. Jobs that will use the most expensive equipment are subsidized. So, if we are not careful, we will only get jobs that use the most expensive equipment.

In this case, we decided to make several different activities for the CNC lathes, but warn the company of the potential danger of selling only the cheapest capability.

ABC model results

There were several surprises in costs. First, a small CNC mill cost much more to operate that a large CNC mill. This occurred because the small mill was not used heavily, but it had some fixed costs such as maintenance that did not vary with use. The maintenance was done on a fixed price contract to an outside firm. Second, the cell (which consisted of a grinder, two CNC lathes, and a CNC mill) was only about twice as expensive as a mill alone. Once again, some fixed costs caused this seeming discrepancy.

MM gets many long-term jobs where they are first told that they have the job and then later are told to produce a batch of parts for that job. Repeated batches are typical over the life of the part. We discovered that the processing of the initial job and of each subsequent batch order was quite expensive. Each seemed to cost about half the price of the typical part, and the cost was constant no matter what the batch size was. The first comment from some management staff was that this was impossible. They could not add that kind of price to some orders and get them. We pointed out that costs are not the same as price, and asked why some orders were a problem. They told us that MM gets some orders for service parts. These orders are often for only one or two parts. This processing cost is the same for one part as for 40. Thus, it will add a lot to the cost of service parts, but have only a small impact on typical batches. We suggested that there were several ways to look at this. For good customers, MM may want to not pass this cost on to their customer. MM needs to make money on a complete job, and the fact that they lose money on the start, make lots of money in the middle and late stages of the contract, and lose money at the end is only an artifact of accounting systems that break costs and profits up into periods shorter than the lifespan of the contract. For other customers, MM may prefer the increase the price sufficiently to cover the complete costs. If the customer chooses to not buy the part, it really is not a problem for MM if they are not angering a good customer. Lastly, they can examine the order processing activity itself to see if there are ways to make it more efficient and cheaper.

ABC implementation results

MM installed the ABC system in October of 1995. In general, they have been very happy, although the impact has not been in the areas they expected.

At present, the ABC system has been used several times to help make decisions about the impact of large jobs on the company costs and whether it made sense to add an additional man in the cell. (The ABC system showed that it would be a moneymaker. The additional person increased production 50% and only increased costs 30%.) Another use has been to identify activities within the company that are large contributors to cost. While there have not been any big surprises here, the data has supported MM management's intuition on where costs are, and has given them more confidence to make changes.

As we noted earlier, a key goal of MM in implementing ABC was to be able to make more accurate quotes and thus get more non-defense business. This has not turned out as expected. The ABC costs for non-aerospace work are lower than before, but not by enough to start winning many jobs.

MM has looked at why their costs are higher than other machine shops and discovered that they are not as efficient as some other shops. The ABC information has enabled them to find exactly where their inefficiencies are. They are now starting efforts to become more efficient and thus more cost competitive. One of their first efforts is to add two more machining cells to their operation. This will allow a large percentage of parts to flow through the cell. This change is being made because the ABC model has shown clearly how efficient the cell is at producing parts.

MM is considering ways to reduce the costs for processing an order. As we noted about, this is a surprisingly large cost and can be quite significant on low cost jobs. It can sometimes be as large as the manufacturing costs for very small simple jobs.

We had expected that the bid differentiation between aerospace and non-aerospace would be in the manufacturing engineering and quality costs. That turned out to be largely untrue. There were differences in cost, but the magnitude was much less. On the other hand, we found several processes that are used only by the aerospace industry, and some of these were quite expensive. For example, MM has a thermal spray unit that is very expensive to have and use and is only used for the aerospace industry.

An interesting problem has occurred with the quoting spreadsheet. The new quoting spreadsheet takes more input data and more front-end work than the old quoting method. In order to use the new quoting spreadsheet, MM's manufacturing engineers must define nearly completely, the process plan for making the part. Quoting was a bottleneck before getting the new quoting spreadsheet. It is now an even larger bottleneck. This is particularly frustrating when MM knows that a significant proportion of their quotes are courtesy quotes that have little or no chance of winning. For the courtesy quotes, the new process is far too laborious. MM's management and we agree that the answer is to define a scheme where only jobs where MM has a significant chance of winning will be quoted using the ABC quoting spreadsheet. Jobs that have very low probability of being won would not be run through the ABC quoting system but instead would be quoted with a simpler method that insures that the quotes are high.

To gauge the impact of ABC on the quoting process, MM took some of their more common parts that they are now making and quoted them using their traditional process and the ABC quoting spreadsheet. The results are shown in Table 6.1.1.

At present, the costs for jobs completed in the plant are calculated using the traditional direct labor and overhead measure. Most of the personnel have not been shown the ABC model. The results of the ABC model has given MM the confidence to raise prices in some cases. So far, the customers have accepted all price increase. So, the ABC model has helped them, but not in the ways they or we expected when we started. MM is planning to update the ABC model this summer. The project team will be helping them in that effort.

Conclusions

A primary motivation for every company we have worked with so far to switch to an ABC model has been to create a "better" estimating model. Every company that has gone through the process has at the end been at least as interested in the strategic and managerial issues that have been surfaced. Clearly, one of the largest benefits of an ABC system is its ability to help guide strategy, marketing, and the improvement process by showing where the large cost elements are.

This project went very well for several reasons. The vice president and chief engineer were both heavily involved and very interested in the process. They are both very competent individuals who have spent considerable amounts of time understanding the details and the strategic implications of the ABC model and how to use it. As a result, we got very good information to start with, and MM has been very good at understanding the uses and limitations of the ABC.

Metrics Results

1. Costs of non-military products decreased but not enough to make MM competitive in the commercial market. Cost reduction efforts were then instituted. In addition, the ABC model reflected a much truer cost of a manufacturing cell. As a result, a second cell was added.
2. MM does not track quote hit rate
3. Improvement priorities - ABC model helped to quantify the cost to process customer orders, this lead to a analysis of where and how the process can be improved.
4. Implementation time - Internal time to implement the ABC model was recorded at 132 hours. These hours included time spent in ABC training sessions, interviews, model building and model usage training
5. Before and after product costs -

Part	Percent change from traditional system to ABC
1	-0.7%
2	2.9%
3	6.2%
4	12.1%
5	22.6%
6	25.3%
7	-1.8%
8	25.6%
9	-2.2%
10	21.8%
11	19.9%
12	25.1%
13	20.4%
14	-2.6%
15	-22.5%
16	-9.2%
17	2.1%
18	-0.5%
19	-7.9%
20	-10.5%
21	26.8%
22	9.1%

Table 6.1.1

6.2 Truck Machining Company

Company Background and Goals

Truck Machining ™ (not the company's real name) makes steering and axle parts for heavy truck and agricultural equipment manufacturers. Approximately 75% of their sales are medium to low volume products for heavy equipment manufacturers for both OEM and aftermarket applications. The remaining 25% is primarily low-volume military and agricultural components.

TM had been distributing overhead using a departmental rate for each of 7 departments. The rates varied from 575% to 724% and were based on the labor and machine support requirements of each department. The overhead rate included all traditional support activities such as setup, product and manufacturing engineering, materials management, accounting, information systems, sales, as well as general and manufacturing management. TM was concerned that they were not competitive on higher volume products and may not be recovering all the costs associated with the low-volume military and agricultural products. The relatively high overhead rates contain many activities that are not used in equal proportions by their various customers.

TM's goal for Activity-Based Costing was to develop product specific rates, rather than general department rates, that would charge more support activities such as product engineering and setup directly to products resulting in lower overhead rates to apply to products. They would also like to use methods other than direct labor content for distributing overhead as they have both automated and manual processes that use differing amounts of direct labor. TM wanted to expand their work in the Heavy Truck market for which they needed more accurate cost information due to the competitive nature of that market. They also wanted to maintain their presence in the agricultural market but wanted to be sure these products were profitable.

ABC Model Design Process and Issues

The process described in Section 4.0 was used to develop the ABC model. First, an overview of ABC was presented to all management employees and key-personnel that would be involved in the interviews and data collection. Following the presentation, two interviewers spent approximately one month gathering the ABC costs; one concentrating on shop floor and support activities, the other on accounting functions and payroll data. The interviewers worked together to sort the data into activity centers and cost pools.

When we felt we had a good base of information on the activities and the cost elements, we held a detailed working session with both interviewers, the ABC model builder and TM's Manager of Financial Analysis and Senior Accountant. Together we reviewed each manufacturing activity to determine its characteristics and cost elements. Activities with similar characteristics (see Table 4.3.1) were grouped together wherever possible to simplify the model building and maintenance. We also reviewed support activities to determine which manufacturing activities or other support activities were the primary users of these activities. For example, we determined that one product made for the

military required 6 hrs of testing for a lot which may take only one hour to run. Also, products with threads required very expensive thread gages.

The working session described above took approximately 6 hrs and at the end of it, we had defined 15 machine or line driven manufacturing activities, 2 labor driven manufacturing activities, 16 support activities, 7 material overhead categories, 5 transaction/event activities, and 7 market overhead categories. The next step was to hold the Mid-Project Review described in Section 4.8 to present the proposed model structure to TM's management team for their review and feedback.

The management team for the most part agreed with the activities and overhead categories the model builders proposed, with minor adjustments to the shipping activity to include more information on the packaging requirements from various customers. Next we needed to collect actual cost data and cost driver data to complete the computer model.

Labor information is generally the easiest element of cost to distribute by activity center. The number of indirect and direct labor required for each activity center is input to the model along with an average labor rate for each activity center. Direct labor rates for TM were close enough that we created two labor categories, Labor Type A and B, each with an average rate. The labor accessed by any manufacturing activity center. Combining direct labor rates in this way simplified the calculation of direct labor payroll and benefits.

Indirect costs, such as indirect salaries and wages, supplies, budgeted expenses, and fixed costs, such as leases and depreciation, were distributed to each activity center either as fixed expenses or using on a multiplier based on operating hours or headcount.

Finally, the completed model and the accompanying product-costing templates were presented to the management team for review. The model contained the cost rates for all manufacturing activities, rates for transaction/event activities, material overhead rates, and market segment overhead rates. The composition of the rates was analyzed and several product cost templates were reviewed. Following the final presentation, a training session was conducted for both the Manager of Financial Analysis and the Senior Accountant. They had responsibility for both using and updating the model.

ABC Model Results

TM's ABC model did not offer any significant surprises but when completed it did support several perceptions management had about their cost. For example, management had felt that the low-volume agricultural jobs they had were not profitable. These products had material that was difficult to get, had several, long setups, and required more scheduling effort then the higher volume heavy truck products. The ABC model confirmed that the rates for these products were not high enough, therefore, TM asked for and received a 35% price increase for many of these low-volume agricultural products without losing a single job. This seems to be an indication that TM's prices had been much lower than their competitors.

The model also gave the company more confidence to go after higher volume work with competitive prices. In the past, they had been reluctant to offer lower prices on some of

this work for fear they would lose money. The ABC model gave them more accurate cost information to make competitive offers to potential customers in the truck market. Unfortunately, the truck market suffered a down turn soon after TM received its model, therefore, they have not yet seen any gains there. They did, however, get some new accounts in the agricultural and industrial markets.

The model provided TM a better way to distribute many support activity costs. For example, in the past Quality and Product Engineering Costs were included in the overhead rates that were assigned to product/manufacturing activities. The ABC model gave them a way to distribute these costs based on market segment/customer so that the customers using these activities the most were paying for them. This was the case with the inspection requirements for a military product mentioned earlier. The model distributed a larger amount of costs to the military market segment. Therefore, the cost per piece for inspection in this market is now much higher than for other market segments.

TM is now beginning to use the model to do other things in addition to product costing. For example, they are looking at the impact new equipment might have on overall profitability. Total costs for the current model are compared to total costs for the model including the new equipment. This is an excellent way to objectively calculate a payback or ROI for capital equipment purchases. They are also planning to create an ABC model for a separate facility that concentrates on the heavy truck market.

Metrics Results

1. Sales have not increased - Down turn in the heavy truck market
2. TM does not track quote hit rate
3. Improvement priorities - Material handling and machine set-up costs were the two areas which stood out as areas needing immediate analysis
4. Implementation time - Internal records reported that employees spend 366 hours designing and implementing the ABC model.
5. Before and after product costs -

Part Number	Prior Method Cost	ABC Cost	Per Cent Change
12004-BNW	$12.92	$10.98	-15.0%
SSB-00506-01	231.25	235.87	2.0%
SS-00219-157	36.39	36.08	-0.9%
4892	5.46	5.71	4.6%
12057	53.94	58.11	7.7%
15331-31	51.99	50.22	-3.4%
15018-15a	13.37	13.25	-0.9%
12819	40.04	42.34	5.7%

6.3 AeroGear Case Study

Company Background and Goals

AeroGear (AG) (not the company's real name) produces a variety of gears for both commercial and defense aerospace applications. Approximately 50% of AG's sales are for one large aerospace customer. Another 10% of sales are directly to the US Government for military applications. Also, a large portion of gears sold to commercial customers ends up in military applications.

AG uses a variety of processes to make gears, including hobbing and shaping, turning, milling, and grinding. The gears also require a substantial amount of outside processing such as heat treat and a variety of plating. Most parts are made from standard bar stock although some are made from exotic types of steel or long lead time forgings. A typical product goes through 20 to 30 operations before it is ready to ship. AG developed product costs using a cost per direct labor hour as well as a cost per machine hour. The machine hour rates included all overhead activities such as manufacturing engineering, purchasing and production scheduling, accounting, quality, and sales. The same rates were used on all jobs regardless of the type of labor or machines used on the job.

AG's primary concern was that their method of developing product costs did not accurately consider the differences in cost for providing service to various customers. For example, one commercial customer had frequent schedule changes and very demanding shipping practices. This behavior caused many operational disruptions including unplanned changeovers and added outside processing costs. Also, the US government and one additional commercial customer have very strict administrative requirements that cause more testing and paperwork. An additional concern was that the amount of manufacturing engineering required for various jobs was not accurately reflected in the flat machine hour rate. For example, some jobs may only require two hours to develop the manufacturing process while a more complicated job may take 20-40 hours of manufacturing engineering time.

AG's goal for ABC was to have a more accurate understanding of product costs by customer. Their largest customer was asking for cost reductions and they wanted to diversify their customer base by providing products to other industries, such as producing gears for the automotive markets for low volume applications. Accurate job costs were essential for making the right decisions.

ABC Model Design Process and Issues

The process described in Section 4.0 was used to develop the ABC model. First, an overview of ABC was presented to all management employees and key-personnel that would be involved in the interviews and data collection. Following the presentation and a plant tour, the two interviewers began gathering activity and cost driver information. The initial data gathering took approximately 4 weeks. One interviewer concentrated on shop floor and support activities while the other interviewer collected Accounting data. The

interviewers worked together to sort the data into categories that fit the activity definitions.

When we felt we had a good base of information on the activities and the cost elements, we held a detailed working session with both interviewers and Mr. Hicks, an ABC consultant. Together we reviewed each manufacturing activity to determine its characteristics and cost elements. Activities with similar characteristics (see Table 4.3.1) were grouped together wherever possible to simplify the model building and maintenance. We also reviewed support activities to determine which manufacturing activities or other support activities were the primary users of these activities. For example, we determined that 80% of the water used at the plant was used to cool the spindles of the finishing grinders. Also, 90% of Purchasing's time was spent negotiating and tracking outside processing operations and the company's truck and driver was almost entirely devoted to shuttling parts to and from outside processors.

The working session described above took approximately 3 hrs and at the end of it, we had defined 8 machine driven manufacturing activities, 2 labor driven manufacturing activities, 9 support activities, 4 material overhead categories, 5 transaction/event activities, and 4 market overhead categories. The next step was to hold the Mid-Project Review described in Section 4.8 to present the proposed model structure to AG's management team for their review and feedback.

The management team for the most part agreed with the activities and overhead categories the model builders proposed, with minor adjustments to include an additional market overhead category. Next we needed to collect actual cost data and cost driver data to complete the computer model.

The model was based on annualizing the last 6 months of 1995 operations. Labor information was somewhat difficult to determine since many personnel changes had taken place during that period. Once the numbers were determined, the indirect and direct labor required for each activity center was input to the model along with an average labor rate for each activity center. A portion of each activity center's labor was allocated to the Setup Activity Center based on the amount of time operators in that activity center had historically spent on setup.

Indirect costs, such as indirect salaries and wages, supplies, budgeted expenses, and fixed costs such as leases and depreciation, were distributed to each activity center either as fixed expenses or using a multiplier based on operating hours or headcount.

Presentation of the final model was delayed somewhat because the Controller was replaced just 1 week prior to the scheduled final presentation. We had a separate ABC overview session with the new Controller to familiarize him with the project and our approach to the model.

Finally, the completed model and the accompanying product costing templates were presented to the management team for review. The model contained the cost rates for all manufacturing activities, rates for transaction/event activities, material overhead rates, and market segment overhead rates. The composition of the rates was analyzed and several product cost templates were reviewed. Following the final presentation, a training

session was conducted for both the Controller and the Plant Accountant. They had responsibility for both using and updating the model.

ABC Model Results

AG's ABC model confirmed that a large part of their support activities could be assigned to products based on the customer or market being served. Market overhead rates varied from 28% to 11% of product conversion costs. Another significant result was the amount of support required for outside processing operations. The model calculated that each outside processing step consumed nearly $42.00 in administrative and transportation costs in addition to the cost of the processing itself.

AG's largest customer had been pushing for small, weekly shipments rather than monthly shipments. The customer had assured AG that this could be done at no additional cost since the customer would pay for the shipments, however, the ABC model showed a different story. Even though the customer paid for transportation of finished product, each shipment still cost over $50 for shipping paperwork, additional packaging labor, and quality certification documents. AG plans to use the ABC model in negotiations with this customer so they better understand how customer demands affect suppliers.

Unfortunately we have not had much time to work with AG to determine how they will benefit from the model. They were the last of the six companies to be presented with the ABC model since they were chosen to replace one of the original companies that went out of business before their model could be completed. The next step for AG is to do more comparison quoting between ABC and their "old" quoting method to get more comfortable using ABC. They are eager to use the information, prove its value, and begin using it to negotiate pricing with their customers.

Metrics Results:

1. Too soon to notice a change in sales dollars or profitability
2. AG does not track quote hit rate

6.4 Auto Plastic Case Study

Company background and goals

Auto Plastics (AP) makes injection molded parts and builds molds for themselves and occasionally for other companies. AP has had trouble winning jobs that have a lot of assembly operations. They suspect that assembly is considerably cheaper than molding, but at present do not have the data to prove it. They hope that an ABC system will help with this effort.

In addition to the assembly cost issue, AP has the following objectives for this project:

Improve the accuracy of their estimating system
Develop new customers outside their traditional base
Identify high cost areas to focus on for cost reduction
Calculate the costs for various alternative business strategies

ABC model design process and issues

The process we used is typical, and is the standard one used for all ABC jobs. First, an overview of ABC was presented to all management employees and key-personnel that would be involved in the interviews and data collection. The University of Michigan professors than gave both the management and selected hourly workers their first survey. We then interviewed several support personnel and shop floor employees to define activities and begin to understand what costs are flow into these activities. Another person worked with the accounting department to consolidate costs into as many meaningful grouping as was possible. They also looked for costs in the ledger that would be directly chargeable to activities or end products or services.

Following collection of the activity and preliminary cost information, we held a detailed working session with the ABC model builder, and several management personnel from AP. Together we reviewed each manufacturing activity to determine its characteristics and cost elements. Activities with similar characteristics were grouped together wherever possible to simplify the model building and maintenance. We also reviewed support activities to determine which manufacturing activities or other support activities were the primary users of these activities. For example, we determined that some plastics compounds created more wear on the molds and equipment and therefore required more maintenance and tool room support. Also, products with multiple colors had longer changeover times and required more scheduling effort.

The next step was to hold the Mid-Project Review to present the proposed model structure to AP's management team for their review and feedback. The management team for the most part agreed with the activities and overhead categories proposed by the review team. It was decided to build one model for the company that accurately reflected the interactions between the various facilities. With the model design in place, the next step is to collect actual cost data and cost driver data to complete the computer model.

The model was based on actual costs for 1995. The data collection process took much longer than originally scheduled (about 5 months instead of 1-2 months). AP management closely held financial information; this was the first time other managers saw the financial information for their activities.

Finally, the completed model and the accompanying product-costing templates were presented to the management team for review. The model contained the cost rates for all manufacturing activities, rates for transaction/event activities, material overhead rates, and market segment overhead rates. The composition of the rates was analyzed and several product cost templates were reviewed.

Following the final presentation, the University of Michigan professors gave their second survey to the management team. The company was then instructed to use the model for selected customer quotations in parallel with current quoting system. Results were to be analyzed to determine any differences. In addition, other members of the management team were encouraged to use the model for "what if" analysis.

ABC model results

The material activity cost per pound for pre-colored material was almost triple that for white or black material. The two major factors that caused this difference were the low

volumes in which pre-colored materials were purchased and the extra quality effort expended to insure proper coloring. Abrasive compounds caused accelerated deterioration of molds and higher mold maintenance costs. These costs should follow the abrasive compounds to the jobs or products in which they are used.

AP received and stored compounds at a site located a mile from the manufacturing facility and incurred close to $150,000 annually in excess material handling costs. This added $0.03 to the cost of every pound of plastic purchased.

AP sells primarily to the automotive market, but has one major customer whose buying habits varied considerably from all of its other customers. The behavior of this customer, which accounted for 20% if the company's sales, caused it to incur over $50,000 in extraordinary support costs. The remaining business required only about $30,000 in such extraordinary costs. This attribution of these costs to the one customer substantially reduced the profitability of its products.

All new jobs at AP require the submission of an Advance Quality Plan. This plan was also required after each engineering change was made. Each time one of these plans was prepared, it cost the company approximately $2,800. Those customers with a history of making numerous engineering changes during a job's life cost the company considerably more to service than those who did not require changes.

ABC implementation results

AP installed the ABC system in the late spring, 1996. Unfortunately, the model has not been utilized as much as was expected. There are two primary reasons for this; first, the person selected to be the model master elected not to be party to the model development process. When the model was completed, this person had to be completely trained on to operate the model. The end result was that the person never felt comfortable with the model and elected not to use it. The longer of time it was not used, the more re-training was needed. The second primary reason for the lack of the model usage was due to the company's decision to seek QS 9000 Certification. This process is consuming the majority of time that would have been used by the ABC model, thus little or no time available to completely learn the power of the ABC system.

Conclusion

An offer has been extended to AP to provide additional model training and also to make model revisions that should make the model better understandable. AP projects that the QS 9000 certification project should be completed by the end of the first quarter, 1997 and would then determine if they wish the additional training.

Metrics Results:

1. Model has only been used on a couple of long term proposals, not enough usage to form any benefits.
2. AP does not maintain information on quote hit rate
3. Improvement priorities - model has not yet been used to identify any improvement areas

4. Implementation time - Internal time to implement system to date was reported as 177 hours. These were spent mainly in training classes and data collection
5. Before and after product costs -

Product	Before cost	ABC cost	Diff.
Fuel pump comp.	$0.139	$0.121	-12.9%
Fuel pump arm cover	$0.109	$0.116	6.1%
Seat Belt bracket	$0.159	$0.145	-8.6%
Roll over valve housing	$0.118	$0.119	0.9%
Interior cover	$0.198	$0.298	50.5%
Water line tee	$0.222	$0.260	17.3%
Electrical Relay	$0.139	$0.121	-12.9%
Baffle	$0.908	$0.998	9.8%
Slide	$0.306	$0.591	93.5%
Cover	$0.326	$0.585	79.5%
Electrode holder	$1.846	$2.620	42.0%

6.5 Clear Plastics Case Study

Company Background and Goals

Clear Plastics (CP) (not the company's real name) has two facilities which produce injected molded plastic parts and interior trim assemblies for the automotive industry. One facility (Plant One) is dedicated to injection molding of interior lighting components and represents approximately one-quarter of the company's sales. The second facility (Plant Two) functions as both the company headquarters and produces interior trim assemblies including lamp assemblies, vinyl and cloth trim, and speaker trim. This facility accounts for the remaining 75% of the company's sales. Plant One provides many lighting components for assembly at the main plant.

CP is also very involved with their customers in product development or "what if" stage of a program. CP also offers its customers complete prototyping services and tooling expertise.

The injection-molded parts are produced on injection molding presses which vary in size from 100 to 750 ton. The trim assemblies are produced primarily in production cells that are dedicated to product families. Labor in both facilities is shared among the various work centers. Plant One has a minimum of staff to support the manufacturing operation and includes Maintenance, Tool Room, Quality Control, Material Management, Human Resources and Manufacturing Engineering. Plant Two has similar manufacturing support staff but also has the corporate staff for Accounting, Sales, Product Engineering, and Information Systems.

Product costs for Plant One are developed using machine rates based on machine size. Plant Two uses one rate based on labor dollars to distribute overhead costs to its products. These rates are updated 2-4 times per year based on labor rate changes. Both the machine and labor based rates include labor, fringe benefits, utilities, and all other support costs.

CP's goal for ABC was to better understand their costs to allow them to be more aggressive in their pricing and, therefore, achieve growth in the automotive interior trim market. Next, they wanted more accurate cost information to help them assess the profitability of long-term contracts over the life of the contract, particularly with respect to the engineering and prototyping services they were providing to their customers. Finally, they also believed that ABC would give them better information on areas to target for cost reductions. Continuous improvement is an important tool for remaining competitive in the automotive industry and the ABC model would help them set priorities.

ABC Model Design Process and Issues

The process described in Section 4.0 was used to develop the ABC model. First, an overview of ABC was presented to all management employees and key-personnel who would be involved in the interviews and data collection. One person interviewed several support personnel and shop floor employees at Plant; another interviewer worked with both support and accounting personnel at Plant Two. The interviewers worked together to sort the data into categories that fit the activity definitions.

Following collection of the activity and preliminary cost information, we held a detailed working session with both interviewers, the ABC model builder, and several management personnel from CP. Together we reviewed each manufacturing activity to determine its characteristics and cost elements. Activities with similar characteristics (see Table 4.3.1) were grouped together wherever possible to simplify the model building and maintenance. We also reviewed support activities to determine which manufacturing activities or other support activities were the primary users of these activities. For example, we determined that some plastics compounds created more wear on the molds and equipment and therefore required more maintenance and tool room support. Also, products with multiple colors had longer changeover times and required more scheduling effort.

The working session described above took approximately 5 hrs and at the end of it, we had defined the manufacturing and support activities for Plant One, Plant Two and Corporate. The next step was to hold the Mid-Project Review described in Section 4.8 to present the proposed model structure to CP's management team for their review and feedback.

The management team for the agreed with the activities and overhead categories proposed by the review team. It was decided to build one model for the company that accurately reflected the interactions between the various facilities. With the model design in place, the next step is to collect actual cost data and cost driver data to complete the computer model.

The model was based on actual costs for 1994. Actual payroll and cost information was difficult to collect due to schedule and philosophical conflicts between one interviewer and CP's financial personnel. The data collection process took much longer than originally scheduled (about 8 months instead of 1-2 months). CP's financial personnel were very skeptical about the usefulness of the ABC model and did not place a high priority on completing it. CP's CEO was instrumental in resolving conflicts between the ABC model builders and CP's personnel so that the necessary data was finally collected and used to complete the model.

Finally, the completed model and the accompanying product-costing templates were presented to the management team for review. The model contained the cost rates for all manufacturing activities, rates for transaction/event activities, material overhead rates, and market segment overhead rates. The composition of the rates was analyzed and several product cost templates were reviewed.

Following the final presentation, issues still remained with CP financial personnel and their perception of the usefulness of the model. They still believed that their "financial model" had more detail and was a more useful tool than the ABC model. Further, other CP personnel felt the ABC model was too complex since the combined model contained all the activities for Plant One, Plant Two and Corporate. After several months of negotiation, it was agreed that the ABC model builders would separate the model into 3 separate worksheets so that the models would be smaller and more easily updated by each facility.

Once the model was separated, it was updated with current cost data and CP personnel were trained in its use. Representatives from Plant One, Plant Two, and Corporate were given responsibility for maintaining their facility's model.

ABC Model Results

The ABC model gave CP more accurate information on the cost of multiple color products and those requiring compounds more difficult to work with. While this information was valuable to the company, perhaps the most important result of the model was that it separated the costs for maintaining and producing current parts from those costs associated with growing the business. CP had recently hired several engineers who were dedicated to developing and prototyping parts for future long-term contracts. These costs need to be looked at as part of the cost of *future* business, not current products. The ABC product cost templates gave the company a way to look at the profitability of a part over its life, including product development, and a way to include direct charges for engineering, quality control, and tool room activities during product start-up. This "life-cycle" approach to product costing also can incorporate changes in material costs, customer prices, and operational improvements over the life of the product.

The primary impact to CP will be the additional information they have for quoting long-term contracts. The model will also provide priorities for operational improvements that are required for CP's products to be profitable over the life of a contract. Many automotive customers are demanding yearly price cuts after a part into production, therefore, cost reductions are critical to maintaining profitability.

We will continue to track CP to see if they continue to use the model or if they revert back to the "financial" model created by the Corporate Finance personnel. The key will be the operational personnel and their perceived value of the decision-making information provided by the model.

Metrics Results:

1. Too early to notice a change in sales dollars or profitability - should help on long term projects

6.6 Donnely Plastics Case Study

Company background and goals

Donnely Plastic (DP) consists of three parts: a mold design and prototype facility; a plastic injection molding company; and a plastics company dedicated to low volume specialty kinds of work. The ABC study will cover the mold design and prototype and injection molding business.

DP has typically supplied a variety of different industries including DoD. Their last active DoD contract recently ended and they have turned down requests to bid on some small jobs for the tank plant because they do not believe that they can be competitive. They are struggling with issues such as how to bid low volume jobs and what the right mix of press

size is. The mold business builds plastic molds for a variety of customers including their own injection business. They are having problems calculating the cost of various jobs and are finding that certain segments of the market are closed to them because of high cost structure.

ABC model design process and issues

The process we used is typical, and is the standard one used for all ABC jobs, see previous company reports for details. The major issue difference with Donnely Plastic was that both businesses had multiple building, thus movement of parts between building was a significant issue. During the implementation process both businesses were re-located into two separate locations. This required a majority of the work done early in the process to be re-done for the new locations.

ABC model results

A significant portion of activity costs was related to the acquisition, storage, and handling of direct materials and outside processing services. Not surprising, the cost of related to standard high volume plastic compounds was relatively low. Although these compounds accounted for 70%-90% of direct material cost, the activities relating to them amounted to only 32% of their material related activity costs. The balance of material activity costs was attributable to a wide variety of low-volume, special types of material, outside processing services, or excessive material movement.

DP sold to both the automotive and non-automotive related customers. Costs related to operating in the automotive market added less than 8% to the activity costs of producing and selling automotive components while 11% was added to the cost of producing and selling non-automotive customers. Much of this was due to having fewer customers who placed larger orders. The result was that 80% of market related costs were spread over 85% of the business. The balance of its market related cost (20%) related to only 15% of its business.

It was determined that cost data by individual press would generate precise, but probably inaccurate and misleading cost information. Therefore, presses were grouped into four categories of presses; small, medium, large, and extra large.

ABC implementation results

The model is currently being used to quote future business opportunities, analyze low-volume jobs to "weed out" those that are marginally profitable, and to run cost studies for cost reduction and new equipment purchases.

Conclusions

While the company is still getting adjusted to their new locations and plant layouts, they have reported that the ABC model has helped most significantly in the customer quotation area. Once production methods and equipment location are finalized, they hope to use the model for cost reduction opportunities.

Metrics Results:

1. Too early to notice a change in sales dollars or profitability - should help on long term projects
2. DP does not maintain information on quote hit rate
3. Improvement priorities - Model notes high cost of material movement and when a job is moved to a larger press than the one the job was quoted on.
4. Implementation time - Internal implementation time to create ABC model was reports as 129 hours. Time spent was mainly on data collection.
5. Before and after product costs -

Part Number	Prior Method Cost	ABC Cost	Per Cent Change
10-12341-3	0.2942	0.304	3.3%
XP-01868	0.1022	0.09	-11.9%
50003	0.2132	0.211	-1.0%
4734040P	0.259	0.249	-3.9%
4734040	0.6191	0.537	-13.3%
10-1249-6	0.1359	0.133	-2.1%
12439	0.2126	0.199	-6.4%
41208	1.5111	1.462	-3.2%
503600/503700	0.0588	0.057	-3.1%
10-12281.2	0.0946	0.093	-1.7%
800-500	0.0186	0.019	2.2%
10-12791-2	0.0873	0.089	1.9%
10-9361-5	0.1187	0.121	1.9%
40679	1.7948	1.654	-7.8%
10-10933-ch	0.1308	0.132	0.9%
7703071/770308	3.6893	3.859	4.6%

6.7 Standard templates

Entering this project it was thought that the activity centers and costing templates would be very similar for the like types of manufacturing companies, i.e., plastic injection companies and metal cutting companies. In practice this turned out not to be the case. This was due to differing types of equipment and processes as well individual company terminology. What were consistent in the template were the types of activities that were machine hour and labor hour driven. When the cycle time of the operation was dictated by the speed of the equipment all companies selected machine hours as the cost driver. When the time of the operation was dictated by the people performing the operation, all companies select direct labor hours as the driver. Below are the activities used in their model for each type of company and how they were divided between machine and labor base.

Primary Activities:

Machining Companies

	Truck Manufacturing	Aero Gear	Modern Machining
Machine hour activities			
	Tie-rod cells	Gear-hob	Plasma Spray
	Tqe rod weld	Mills/lathes	CNC grinding
	Tqe rod weld	CNC opera.	Manual grinding
	Tqe rod assay	Reishauer	Hurco mill
	Spf tube operas	OD/ID center grind	W-S Milling
	Tie rod assay line	Spline grind	Manual mill
	Pwr cycl cell	Detroit/Red.	LeBlond CNC
	V-rod Assay line	Saw	Mon/Swd Horz.
	Vertical R & B		Mon Vert. lathe
	Sp. Bearing line		EDM cutting
	Farm mach opera.		Machining cell
	Other mach opera.		NDT testing
Labor hour activities	Farm labor opera.	Set-up	Edge Break
	Set-up	Buff & Assay	Other manual operas.
	Other labor operas.	Routed Inspection	Prod. Manpower
Other Activities	Purchased materials	Cost of new job	Purchased materials
	Market type	1st piece approval	Outside operations
	Customer behavior	Outside processing	Tooling overhead
	Shipping	Shipping	Customer order
	General & Admin.	Customer support	Internal job scheduling
		General & Admin.	Market support

Plastic Companies

	Donnely Plastics	Auto Plastics	Clear Plastics
Machine hour activities	1000 TON Press	Large Press	Die electric
	Large Press	Medium Press	Foam operation
	Medium Press	Small Press	Horn assay
	Small Press	EDM machine	Cell operations
		CNC machine	Mold-by press size
		Manual machines	
Labor hour activities	Production labor	Production labor	Maintenance
	Indirect assay labor	Tool labor	Mfg. Engineering
	Welding	Engineering	Qual Control

	Set-up labor	Die setting	Direct labor Fabricate
Other activities	Matl o'head-blended	Material o'head	Mold technology
	Matl o'head-non-abr.	Customer support	Drying operations
	Matl o'head-abrasive	General & Admin.	Material handling
	Outside processes		Matl o'head
	Package material		Outside processing
	Drying operations		Shipping
	Difficult mold		Release Cost
	Average mold		Corp. Eng.
	Easy mold		Bid & Proposal
	Line items shipped new tooling		General & Admin.
			Growth & Development
	Customer type		
	General & Admin.		

Other activities are generally those activities that under traditional costing systems were included in the overhead pool. These costs were assigned to a product by either machine hour or direct labor hours, i.e., they were assigned based on a variable that had little or nothing to do with the cost of the activity. Companies in this project were able to identify and assign costs based on the type of material being used, customer or market being serviced, cost to have manufacturing operations done to a product by an outside company, and costs of activities that vary with either the manufacturing process, materials, customer, or market. These other activities are the ones that normally make an ABC cost model the unique and more cost accurate tool that it is.

All the companies in this study had secondary activities where costs were accumulated for internal cost reduction and process improvement analysis but were not identified as a primary cost activity for product costing purposes. In the model they were rolled-up into other activities. Listed below are some examples of secondary activities that were highlighted by the companies.

Secondary Activities:

Machining Companies	Plastic Companies
Maintenance	Maintenance
Machine Repair	Inspection
Inspection	Material handling
Customer Returns	Purchasing
Accounting/Payroll	Warehousing

Personnel	M. I. S.
Customer quotations	Regrind operation
Receiving	Personnel
Stockroom	Bid/Quoting
Physical Inventory	Division Management
Customer Service	tooling
Corporate Charges	New Technologies
Tool maintenance	Growth & Development
Marketing	Financial Mgt.

Secondary operations can be a primary source for cost reduction efforts, since under traditional costing systems, their costs were unknown.

Costing and Quoting templates

The templates for product costing and customer quotations were designed to operate the same for all companies in this study. The individual activities were different and unique for each company but the method to apply them to a product, market, or customer were the same. The model user would enter a variable for each activity based on the frequency of need of the activity for the product. For example, the estimator enters the type, price, and amount of materials needed for the product. The template will then extend by the quantity of parts to be produced and also add the cost of the appropriate material overhead associated with the amount of materials. This approach is used for all activities on the template, user enters the amount needed, materials, production hours, number of set-ups needed, etc. and the template extends the cost. The secondary benefit is that the user enters data for only those activities that are needed to produce the product. If an activity is not needed for the product, no cost is assigned. The end result is a more accurate product cost.

An example of a quoting template was shown previously (Enterprise engineering template) in Section 3.7. This is a real template developed for a real firm, but the numbers have been changed to protect trade secrets.

7.0 Metrics

We attempted to measure the following items:

Changes due Directly to More Accurate Cost Data

Before and after ABC estimated costs—look at a sample of jobs and compare before and after ABC estimate of costs.
Before and after actual costs—compare completed jobs costed by new ABC system with what they would have "cost" with the old system.
Quote hit rate.
Sales variability—what types of jobs are won and lost.
Areas of business that declines—jobs rejected.
Change in Sales volume—we expect shifts in mix, but not large swings in volume in the short term.
Cost to implement and maintain ABC system—requires firms to collect "time spent" on the ABC implementation.
Change in Profitability.

Changes Due to Better Cost Knowledge by Company

Cost reduction plans—before and after—cost reduction focus of company—focus for improvement efforts.
Process improvement focus.
Capital improvement plans—before and after.
Productivity—(value added per employee)
Resource utilization—how much which machines will be used.
Internal company productivity measures.
Overall market strategy before and after ABC.
Specialty order pricing/variable cost understanding—does it damage the marketplace —is it a one time occurrence.
Before and after market/product line.
Outsourcing decisions—criteria before and after.

The results of the measurements are included in the case studies for each company. It was often difficult to separate the impact of ABC from market changes, and some of the companies did not track much, which made it difficult to gather data.

7.1 Summary of Attitudinal Changes in Companies Implementing ABC

Introduction

This report describes the analysis of the survey data collected at 3 implementation sites in the ABC agile manufacturing study. Because of the data limitations described below, the analysis is limited to a description of some of the attitudinal changes that accompanied the implementation. As with all studies of this type, it is not possible to trace causal relations.

Description of Data

The data for the analysis were collected in a series of site visits. The original plan included three data collection visits at each of the sites. The first visit took place prior to any implementation activity and was used to collect data on views towards cost information and the general environment at the firm. The second visit was originally designed to coincide with the 'hand-off' of the ABC model and a short training presentation on its use. The final visit was scheduled to take place at least six months after the completion of the model and was designed to evaluate the use of the model and the impact that it had on decision-making. Surveys 1 and 3 were given to management and employees in separate sessions and survey 2 was given only to management.

The small number of manager respondents limits the interpretation of the data - a factor that was likely to occur since the study was aimed at small firms. Exacerbating this, however, was the need to have the same respondents over time. Turnover, therefore limited the size of the sample still more. In what follows, all results should be viewed as, at most, suggestive, and not statistically reliable. While all steps were taken to ensure consistency in the administration of the surveys, compromises occasionally occurred to accommodate work schedules, unplanned absences, etc.

Our analysis is limited to comparing the construct measures across firms for a given survey and across surveys for a given firm. The first comparison allows us to assess differences among firms in attitudes towards cost information and a variety of other factors before ABC implementation, at the time of ABC implementation (for two of the firms), and after having ABC information potentially available for six months. We do not assess the ABC information itself or the impact on decision-making. There was not enough information available for such an assessment.

Initial Conditions

The administration of the surveys was planned so that the first survey took place before the ABC implementation phase began. The assumption is that, to the extent managers and employees were aware of ABC methods, it came from outside the organization and was unlikely to be the result of personal use of the system. We analyze the data in two ways. First, for each firm, we compare the responses of managers to that of employees. This

allows us to describe how the organization and the cost system is viewed by the two groups. The second analysis looks at the three firms for each group of respondents (managers and employees). This analysis allows identifying differences in attitudes across firms that may be useful in understanding later success in the implementation or use of ABC. Some of the areas studied in the survey are attitude towards teamwork, value of external consultants, views of cost system accuracy, cost system training, commitment to the company, and the value of intrinsic rewards.

Conclusions: Managers Vs Employees

Modern Machine (company 1): Employees expressed a more positive attitude toward teamwork and expressed a greater belief about the value of external consultants. To the extent that both traits are important in the implementation and use of new cost systems, and since the consultants work primarily with managers, these results may suggest a more difficult time in the implementation process.

AutoPlastics (company 2): The data suggest that managers felt more disagreement among themselves than how they are viewed by employees. Managers also felt there were more group differences and less clear goals for the management team. This suggests some potential for difficulties in the implementation of a new cost system where managers are unclear of the reason for switching to ABC.

Truck Machining (company 3): Compared to managers, the employees were more likely to associate cost reduction efforts with bad experiences than were managers. Interestingly, these employees also found the manufacturing environment more uncertain than did managers. This was the only one of the three firms where employees disagreed with managers about the frequency of oral communication to interact with supervisors and subordinates. This may indicate a potential problem with obtaining employee cooperation with the implementation efforts of a new cost system.

Conclusions: Comparisons across companies

The next analysis considers responses by each of the groups (managers and employees) across the three firms. The purpose of this analysis is to identify potential obstacles to the successful implementation and use of a new cost system. Differences between the companies appear in the constructs for level of conflict, the awareness and need for costing information, the uncertainty of the future, group cohesiveness and the clarity of group goals, management commitment to cost reduction, open group processes, centralization of decision-making, and the use of written communication from supervisors and subordinates.

Conclusions

Company 1: Appeared to have the most successful implementation in terms of both system usage and senior management acceptance of the system. This is consistent with a

management group that has relatively little conflict and which shares common goals. Thus, the data are not inconsistent with predictions.

Company 2: Consistently low in the group constructs suggesting a relatively high level of conflict within the management group over goals. This may make it difficult to have a successful implementation of a new cost system. Shows a pattern of conflict at the management group level. This is expected to be related to less successful implementation and use of a new cost system. While the data do not exist to test this hypothesis, there is some anecdotal evidence that the system has not, at least to this point, been widely used.

Company 3: Has the highest score for cost system need, indicating that they may be more receptive to ABC.

In looking at the employee responses across companies, there is less cross sectional variation than among managers. This is to be expected when considering issues mainly dealt with by management. The one interesting difference, and a difference consistent with the results for managers, is the relatively low score for open group processes for Company 2. Again, this suggests that implementation and use of a new cost system would be more difficult in that environment.

Implementation of the ABC System

The second survey occurred at the time of the hand-off of the ABC model. Second survey results are only available for Companies 2 and 3. In addition, only managers were surveyed at this time since employees would have been, for the most part, unaffected by the development of the ABC model.

The results of the initial survey are echoed in the second survey. Large differences were found between Companies 2 and 3 for constructs relating to the ABC system (accuracy and use), the level of conflict, group dynamics, management commitment to cost reduction, bad experiences with cost reduction, and the likelihood of rewards following good performance.

For all these constructs, Company 2 was consistently lower than Company 3. These results, combined with the results of the first survey, are consistent with a company that will experience difficulties in the implementation and use of a new cost system (or many other types of management information systems). As noted above, the findings for individual constructs are difficult to interpret because of small sample sizes and questions of construct reliability. However, between the first and second survey, the results are consistent that, if data were available for a test, we would hypothesize that Company 2 would experience more problems with implementation and use of a new ABC system than either Company 1 or Company 3.

Experience Six Months after the Implementation of the ABC System

The final survey was taken approximately six months after the hand-off of the ABC model to the managers of the individual companies. At this time, both the managers and employees were surveyed. As with the pre-implementation results, we first analyze

manager-employee differences within companies and follow-up with cross-sectional differences among the three companies.

Conclusions: Managers Vs Employees

Company 1: The results, when compared with the first survey are interesting for not only the new differences that arise but changes in the relative rankings. In the third survey, after six months of system use, there are differences between managers and employees for constructs related to teams, the value of the external consultant, the impact of the new system, and the overall assessment of ABC.

Company 2: There was little change from the first survey in the relative responses of managers and employees. Differences occurred with respect to the impact of the ABC system and the overall assessment. As expected, both scores were higher for managers. Group differences continue to exhibit a higher score for managers.

Company 3: Results are similar to those of Company 2. Differences in scores between managers and employees were identified for constructs relating to the accuracy and use of cost system information and the impact and overall assessment of ABC. Again, managers rated the impact and overall assessment higher (probably because of a greater familiarity with the system). One other change of interest had to do with attitudes towards teamwork. In the initial survey, employees scored higher than managers. In the third survey, there is relatively little difference on this construct.

For the ABC constructs, managers consistently gave higher scores than employees. This might be expected since the initial use of a new system would be expected to start with the management team. However, the yearlong process also resulted in a switch in scores for attitudes to teamwork and attitudes about the value of external consultants. In both cases, scores for both constructs were higher in the initial survey for employees and lower for managers. This was reversed in the third survey.

Conclusions: Comparisons across Companies

There are two results that appear when looking across the three companies six months after the hand-off of the ABC model. First, the differences continue to center around group conflict, goals, and cohesiveness. As before, scores on these three constructs are widely different. In addition, there are differences in the perceived awareness of costs, the need for cost information and the importance of cost information. Company 2 scores are consistently lower across all these constructs. Company 2 also has the lowest score for management commitment to cost reduction activities.

Second, while Company 2 continues to exhibit problems along the group dimension, the scores for Companies 1 and 3 appear to have moved closer together. This would suggest some change in Company 3 that may have a positive impact on the use of the new ABC model in the coming months. Unfortunately, we are unable to determine whether that use will, in fact, occur.

Among employees, the only two constructs which exhibit differences are those for future uncertainty and management commitment to cost reduction efforts. Employees in Company 2 feel they face a much less uncertain environment than those in either Companies 1 or 3. Like the managers, employees in Company 2 give the lowest score to the commitment of management to cost reduction efforts.

Changes in Views over Time

The final set of analyses involves the change in construct scores for a given firm over the life of the project, i.e., from survey 1 to survey 3. We analyze management and employee responses over the three (managers from Companies 2 and 3) or two (all employees and managers from Company 1) surveys.

Company 1: The results suggest relatively little change over the period. To the extent that management had consistent goals and provided an atmosphere conducive to change, we would not predict that a new cost system would affect that. Since Company 1 did not participate in a second survey we are unable to assess the changes in views towards the ABC system over the six months after the receipt of the model.

Company 2: As with Company 1, there appears to have been little change over the period in the attitudes of the managers and employees of Company 2. Again, given the difficulties already identified with some of the group constructs, it is unclear what, if any effect the ABC system had or if it has been used by many managers.

Company 3: Company 3 is the only site where there appear to have been changes over the study period. The constructs that exhibited changes are future uncertainty (for both managers and employees) and group differences (for managers). Both managers and employees feel an increase in the uncertainty surrounding the company. The change in the group differences appears to represent a dip during the second survey with managers' attitudes returning to the original position at the time of the final survey.

Summary

Without information on the use of the ABC model, it is not possible to assess the extent to which the attitudes analyzed in these companies affected their experiences. Also, as described above, data limitations preclude us from testing any hypotheses in a statistically reliable way. As a result, we look at mean differences and use an analysis of variance approach to ***suggest*** constructs that may be different across time and across firms.

To the extent we can draw any conclusions from the data, it is that Company 1 would have the best set of conditions from which to implement and use a new cost system. Again, there is anecdotal evidence that this has, in fact, proven to be true but it is not possible to test this statistically. In the same way, we would expect the most problems with implementation and use at Company 2. There is some evidence in the data that Company 3 may be in the process of changing toward a management group that will enhance the probability of successful implementation and use.

7.2 ABC Model design and implementation costs

Costs are defined in terms of days, not dollars to correct for differentiating consultant costs and company costs.

Company	Consulting Days	Company Days
Modern Machine	52	18
Truck Machining	40	25
AeroGear	37	n/a
Auto Plastics	45	n/a
Clear Plastics	69	n/a
Donnelly Plastics	37	n/a

8.0 Tech Transfer Activities

The primary tech transfer activities have been through the NIST MEP system. We have created several courses in which we have embedded the knowledge we acquired from this program. The courses are:

The one-hour overview is designed as a tool to introduce the ABC concept to company officers and to teach them how to recognize the need for ABC in their organization.

A four-hour introduction to Activity-Based Costing - This is intended for people who want an overview of ABC. This workshop focuses on basic Activity-Based Costing concepts and implementation, including what is ABC, how does it compare with standard costing methods, how to utilize the new information, how to start implementation, what are the prerequisites for a successful implementation, and what are some pitfalls to avoid to ensure success.

A four-hour course on Activity-Based Quoting - This workshop is for those companies who desire an improved customer quoting system and who do not have an Activity-Based Costing system currently in use. It is very similar to the 4 hour ABC Workshop, the only difference being the focus on quoting. The workshop will demonstrate the use of Activity-Costing Concepts with the end product being a cost quoting template. This is a hands-on course where participants utilize a case study to learn the Activity-Based Quoting techniques. Participants will be exposed to ABC concepts, general ledger data, as well as a discussion on the benefits of Activity-Based Quoting over conventional quoting methods.

The ½ day presentations have been given many times to a variety of different audiences. These courses have been given over 20 times in Michigan to manufacturing companies within the state. It has been delivered to 85 MEP staff members at the Modernization Forum Conference in April 1997, and it has been delivered to about 20 MANTEC staff at Wright Patterson Air Force Base. It has also been delivered to a team at Lockheed Martin's Missile division in Orlando, Fla. who are considering using ABC as part of the Multiple Missile Program.

A two-day course in ABC designed for those who need a detailed understanding or plan to be involved in the implementation of an ABC system in a company. It presents the ABC concept, teaches how to define and collect needed data to build an ABC model, and gives some hands on experience in using the model and provides hands-on experience in decision making based on the data obtained.

The first day presents the activity-based concept, how it impacts a company, and how to present the concept to clients. The second day expands on the day 1 concepts beginning with the development of an ABC model and provides hands-on experience in decision making based on the data obtained from the model.

This course includes:

How to improve product and process costing with the ABC concept.
The steps to build an ABC system and the tools available.
How to interpret cost data to improve general operations, assist in strategic planning, and develop pricing strategies.
How to sell ABC and other costing system projects to manufacturers.
About the benefits and challenges of implementing an ABC system.

This course is intended for anyone who needs to understand in detail how to gather data and create an ABC model, and what to do with it after you have it

Course Content:

Day 1 - Understanding Your ABC's

Overview of Accounting Principles and Traditional Costing Systems.
Cost information in Business Decisions
Identification of Common Problems in Costing Systems
The ABC Model
Introduction to the ABC Concept
Analyzing ABC in a Company
Developing ABC Projects
Factors that Affect ABC implementation
Benefits of ABC
Developing time/cost estimates for ABC projects
Selling ABC projects

Day 2 - Using the ABC Model

Identifying Activity Centers
Data collection for model building
How cost is transferred to the product
The Schedules in the Model
Walkthrough of the model
Decision-Making Using the ABC Model

Testing and learning from the model
Next Steps

The 2-day ABC course has been given at the MEP centers in Iowa, and Georgia Tech, and soon at Los Angeles. MEP centers at Georgia Tech and Los Angeles are beginning to offer ABC services to local companies using this model.

In addition, this report is posted on the ITI Internet site, along with some overviews of ABC, and some service descriptions. This section is the most visited part of the ITI Internet site, and we have gotten requests for information from a variety of people as a result.

9.0 Conclusions and Recommendations

9.1 Impact on Companies

We have seen some clear benefits, but not necessarily in ways we expected. For example, we expected that better cost data would allow the companies to diversify into additional markets. Thus far, this has not happened. MM discovered that even though their costing was more accurate, their overall costs were too high to consistently get work outside of the aerospace market. They are however working now to reduce those costs and may eventually be able to enter commercial markets. The ABC effort has given they crucial data to guide their improvement efforts. TM decided to focus more deeply into their core business, the heavy truck market, because they discovered they were not making money on other smaller markets. They concluded they would have difficulty getting price increases large enough to sufficiently cover the cost of serving some other markets such as aftermarket agriculture. Perhaps what the companies have found is not that ABC will allow them to compete in all markets, but that it gives them information on the markets in which they can successfully compete.

All six companies started the project with at least one of their goals being more accurate quoting. By the end of the project, all six companies became just as interested in the strategic, marketing, and operational information that the model gave them. Examples of how the models are being used include making capital acquisition decisions, selecting cost reduction projects and targets, making lines of business decisions, and operational changes. Outside of product costing, the area where the six companies have seen the most benefit is in identifying opportunities for continuous improvement activities.

Perhaps the most significant benefit we have seen from all companies is a better understanding and awareness of costs. It is clear that all six companies have come a long way in their understanding of their cost structure and what that means to their business. Most are now sharing cost information more freely employees and they are talking about the impact of operational changes on product costs and in turn, company profits.

9.2 ABC Issues for Small Companies

Much has been written about large companies their experiences with Activity-Based Costing. While the companies in this study were overall positive about their models and the benefits they perceived, most did not make full use of the model for decision making,

but rather tended to primarily use just the Quoting Template. Following are explanations of what we found to be the special issues facing small companies as well as recommendations for getting companies to make more complete use of the model's capabilities.

1. Resource Requirements

Activity-based cost models are usually developed as a tool separate from the day-to-day accounting system. As such, it requires separate maintenance and additional effort to use it as a decision making tool. Most of the companies in our study gave responsibility for maintaining the model to the company controller, however, the controller is usually not the primary beneficiary of the model's capability. The controller continues to have responsibility for preparing financial statements, preparing tax paperwork, and arranging financing. The real benefits of the model are in its capability to help operational management make decisions regarding pricing, capital equipment acquisitions, and plant improvements. Since the controller does not perceive direct benefits to their responsibilities, they do not have a compelling reason to make extensive use of the model. At the same time, operational management has not been sufficiently involved in the model development and training to be able to use it without accounting assistance.

Operational management personnel in small companies are typically very pressed for time. Small companies rely on operational management to perform many, varied functions that larger companies employ technical and clerical staff to handle. In our study, the operational management personnel were very stretched for time and had little time to get involved in model development and training. Even though they attended the initial "Kick-off" seminar and the Mid-Project Review, they had little exposure to their company's model and its use in making cost decisions. Without their support, companies usually do not achieve the full benefits possible from an Activity-Based Cost model.

2. Perceived Value

Even though upper management believed in ABC, we were unable to provide them with clear financial benefits that would make them committed enough to make using the ABC model a top priority with their management team. In most cases, other improvement efforts, especially QS-9000, took priority over the ABC project. Until companies are able to perceive significant benefits, it will be difficult to get the commitment required to make full use of the model's capability.

3. Employee Turnover

Another issue facing these companies and many small companies is the rate of employee turnover. Of the six companies, three had changes in the controller position during this study. In one company, almost the entire management staff was replaced halfway through the project. Turnover of key employees lengthens implementation time, can cause the project to lose focus, and in turn leads to an implementation the yields fewer benefits.

9.3 Lessons Learned

Although each of the six companies involved in the study derived benefits from the ABC model, none of the experiences would probably be considered "perfect". The different challenges faced by each company gave us insight into what approaches worked well and which ones were not as effective as desired. Here is a summary of improvements in the process that we feel would lead to more effective ABC implementations.

1. Educate Company Executives and Managers.

During the projects we focused our education on ABC concepts, however, we found that most small company executives do not have a good understanding of even basic financial information. Education on the basics of using financial information will help ensure a buy in to ABC cost data. Examples of misunderstanding are:

Direct verses indirect costs - This categorization of costs may have made sense when most costs were direct costs and overhead was truly overhead. In today's manufacturing plants, most activities can be traced directly to products. For example, even though CAD design is considered an indirect function, often it can be charged to a product or job just a direct labor can. Companies should make the effort to change their accounting and reporting systems to allow such activities to be charged to jobs.

Fixed versus variable costs - Companies typically look at fixed costs and variable costs as a way to categorize costs and think about how different scenarios will affect cost. But in many ways costs go up and down in steps rather than as a continuous function. In the short term, most costs are fixed and in the long term, most costs are variable. For example, even though labor is considered a variable cost, removing a product or job will only reduce labor costs if personnel are laid off or overtime is reduced. In the same way, costs do not necessarily increase by adding a job unless overtime, support people, or additional machinery or supplies are needed.

The "correct" cost model - Most people believe there is a "correct" cost model if we can just find it. But in order to estimate costs, we must first predict the future. ABC models are a prediction of what will happen in the future. The only way to get an accurate cost for something would be to make it, liquidate the company, and then calculate costs. Even then, if you made more than one kind of thing in that plant, you would need to allocate costs between these products. So, ANY cost model is always approximate, and alternative models showing different costs can be created.

Smooth versus chunky costs - Many cost models are described as continuous functions. This means that any changes in volume translate immediately to changes in cost. In real like, costs are chunky. Unless you hire a new person, buy a new machine, add more space, etc. costs have not increased, even though you may be doing more work. Conversely, unless you can lay off a person, sell a machine, or rent out that unused space, you have not reduced costs.

2. Get Involvement from Users of Activity-Based Costing Information

Our initial target for selling ABC was typically the company Controller. Although we found interest here because they thought the model would produce some good information for upper management and/or owners, they also saw using and maintaining the model as an additional task to their day-to-day duties. As a result, building and using the model did not receive a high priority.

In two instances, our initial contact with the company was through the owner or president. In one case, Modern Machining, this approach was very successful since it was a small company without a full time Controller. MMs President was very interested in knowing more about his actual costs since he had very little financial information available. He wanted to use the model to assist with quoting decisions and was very supportive and prompt in gathering the data necessary for the model. In the second case, CP, the Owner was unable to drive the project himself due to the size of the company and therefore relied on his financial staff to assist in data gathering and model building. This proved mostly unsuccessful since the financial staff were not big supporters of ABC and felt they had all the tools they needed. They did not share the Owner's view that detailed cost information for each product was critical to the overall company profitability.

The conclusion we have reached is that the more involved the operations people were, the greater the chance for success. An Activity-Based Costing approach must be supported by those who can not only use the information, but also have responsibility for developing and maintaining the model. Support without involvement or involvement without need both cause problems in making ABC a priority and in sustaining interest in using and maintaining the model once it is developed. This combination of both need and responsibility tend to be found at the operational level such as Operations Managers, Engineering Managers, and other individuals responsible for either quoting or continuous improvement activities.

3. Demonstrate Practical Benefits

The initial purpose of the project was to provide case studies that could quantify the benefits of ABC for small companies. While the companies involved were able to achieve some quantifiable benefits, they were not a numerous as we originally hoped. This is explained in part by the length of time required to complete the original models.

After our experiences with these six companies, we are even more convinced that companies must be presented with real life, practical, quantifiable benefits in order for them to fully support an ABC implementation and make the development and use of the ABC model a priority. Among the practical benefits that are successful in getting companies to implement ABC are:

Recognition by customers that they are actively working to identify and reduce costs
Accurate quoting that includes all aspects of the company
Identification of areas of large, non-value added activities such as inspection

4. Complete ABC Implementation on Time

The process identified for implementing ABC in this study called for each model to be completed over a 3-4 month period. All six models were targeted to be completed within 12 months leaving another 6 to 12 months to track progress. Unfortunately, several circumstances arose so that only 3 of the models were delivered in the first 12 months. Some of the circumstances included:

A complete management reorganization in which only one person from the original team remained at the company (Donnely Plastics)
A company that filed for Chapter 11 and subsequently closed its doors. This company's model was nearly complete when they had to be replaced in the study.
Internal disagreements over whose responsibility it was to provide data for the ABC model (Clear Plastics)
Two companies had Controllers that left 2/3 of the way through the implementation. In both cases, the implementation was delayed by approximately 2 months.

In cases where delays stretched the implementation time beyond 4 months, we ran into considerable difficulties with maintaining enthusiasm as well as problems with keeping up with operational changes. For example, at CP, the first version of the model was not completed until approximately one year after project start. When finally completed, activity center definitions had changed, and the company's sales had risen sharply.

Another danger, mentioned earlier, is employee turnover. If ABC models are not completed in three months or less, the chances for employee turnover become much greater. Whenever new people are introduced into the project, time is lost in educating newcomers, reviewing what has been done to date, and possibly redoing parts of the model to suit the perspective of the new employee(s). This causes delays in seeing results from the model and adds to the cost of implementation

5. Fit the Model Complexity with Company Needs

Although we tried to keep the ABC models for the six companies as simple as possible, we still received several comments that the models were complex and difficult to work with. These comments have lead us to conclude that it may be better to sacrifice some accuracy in order to get a tool that users can easily understand and maintain. Some ways to simplify the model are:

Combine support activities to reduce the total number to six or fewer
Combine manufacturing activities to total no more than 8. Manufacturing activities which can be successfully combined are:
- equipment with one operator per machine
- labor driven activities such as assembly operations
- equipment dedicated to producing a similar group of products can sometimes be combined into "a cell"
- CNC machining operations with similar cost profiles

6. "Off-line" models are better than "on-line" models

We also found that the "off-line" models we created were better than those connected to the day-to-day accounting system. Many accountants believe that ABC models must be linked to the accounting system with frequent updates in order to be useful and correct, but we found that there were dangers and limitations in having a direct connection. Fluctuations in on-line data due to short term changes in volume or mix often lead users to believe they should update their cost rates even though the underlying cost structure has not changed. We have seen companies that updated their cost structures monthly, and all it did was to confuse their staff and their customers. The "off-line" model approach assures that cost rates are only updated based on longer-term trends or significant changes in activities, or products.

There are also often costs that we might want to consider that are not included in a typical accounting system. An example of that would be the cost of inventory. If inventory is financed out of profits, then the opportunity cost of having that money tied up is not shown in any accounting system. Companies that were considering improvements that reduced inventories would like to know the full cost of carrying that inventory and thus the cost savings that might result. A company that was considering several different production techniques with differing amounts and kinds of wastes might want to consider potential liability that would accrue with each different technique even though there was no immediate cash outlay. Companies with fully depreciated but still valuable machines might want to use the market value of the machine to calculate the cost instead of assuming (as many do) that the machine is "free". In situations where the technology has changed significantly, we often suggest that companies consider replacement cost instead of depreciation. Once again, this is something that is not on an income statement.

7. Document the Model Thoroughly and Clearly

If the model can be sufficiently simplified and it is clearly documented, users are more likely to try to use it on their own. Self-sufficiency in using the model is essential for long-term success since most users do not want to rely on "consultants" indefinitely.

8. Make the Model 'Pretty"

We found that companies that were very intimidated by the model initially became much more comfortable with in when we spent some time formatting and color coding it to make it easier to read. The more work we have done, the more clear it is that this is vitally important. We now spend considerable effort formatting the model to make it more readable.

9. Training and Support are Essential for Success

Training in ABC concepts and model maintenance is essential for users to feel comfortable using the ABC data to make important decisions about their company. On-going support from the model builders as well as encouragement from any customers or sponsors will greatly increase the chances that a company will stick with ABC and use it regularly in the decision making process. All companies required longer to get familiar

with model maintenance than we had initially anticipated and we estimate that most companies need support for about six months to one year before they feel comfortable to use the model extensively on their own.

10. Relative costs of Manual versus CNC Machining

One of the bigger surprises we had was the cost of CNC machining compared to manual machining. We expected CNC machining to be more expensive per hour than manual machining, but that it would make financial sense because CNC is so much more productive. In fact, CNC was cheaper to operate on a per hour basis than all but the largest and most expensive CNC equipment. And this data was based on using the equipment considerably less that the 20 hours per day that the most efficient shops achieve. Thus even lower costs per hour are achievable. To illustrate this, we have included the quoting template for a company (not one of our case companies). We modified the usage of the CNC machines to produce a model of an efficient shop running 2 shifts. This model is shown in the chart below.

Activities	Driver	Activity Cost
Machine		$ per hour
Tarus	Machine Hours	$75.13
Cincinnati Mill	Machine Hours	$52.68
Lg. Fadel/Sharrnoa	Machine Hours	$31.74
Sm. Fadel/Sharrnoa	Machine Hours	$23.28
Sm. CNC	Machine Hours	$16.46
EDM	Machine Hours	$31.03
Manual		
Benching	Labor Hours	$41.08
Manual Machining	Labor Hours	$43.29
Assembly	Labor Hours	$41.19
Tryout	Labor Hours	$33.96
Weld/Spot	Labor Hours	$45.30
CMM	Labor Hours	$44.52

As you can see, manual machining is more expensive per hour than all but 2 of the categories of CNC machines.

This result has appeared in many different models and appears quite universal. Note also that this does not consider the higher productivity of CNC. It is the result of CNC typically not needing a dedicated operator and the need for more supervision for manual machining. The conclusion here is that all machine shops should switch to CNC as fast as possible.

11. Variability of the model

We picked two sets of 3 companies that were very similar deliberately hoping that we could define a "standard" model. While many of the activities are common, the detailed

costs of these activities differ considerably, often because they are performed differently in each company. In addition, there were many different activities in each company. These differences also reflect differing strategies and markets that apply to each company. The net result is that while there are overall similarities in structure, each model must be individually designed for each company.

9.4 Recommendations for Department of Defense (DoD) Actions to Encourage and Facilitate Implementation of Activity Based Costing (ABC) by Defense Contractors

Background. The environment of negotiated federal government contracts is highly regulated by the Federal Acquisition Regulation (FAR) system, the Costing Accounting Standards (CAS) Board, and frequent legislation. These aspects often unintentionally discourage or make difficult the implementation of Activity Based Costing (ABC) techniques that have been successful in a less constrained commercial environment. The objective of this section is to provide recommendations for Department of Defense (DoD) actions to encourage and facilitate implementation of ABC by its contractors. Recommendations are presented at the conclusion of each of the following topics.

1. Increased Costs to the Government for Voluntary Cost Accounting Changes and Cost Accounting Standards (CAS) Impact Statements. FAR 30.602-3 (a) (2) provides that a contract price may be adjusted for a voluntary cost accounting change; however, increased costs resulting from a voluntary cost accounting change may be allowed only if the Administrative Contracting Officer (ACO) determines that the change is desirable and not detrimental to the interest of the government. According to DoD CAS Working Group Item 79-23, "desirable" encompasses the test of being appropriate, warranted, equitable, fair or reasonable and a change may be desirable and not detrimental to the interest of the government even though it increases costs. Despite guidance to the contrary, ACOs invariably consider that any voluntary cost accounting change that increases the cost to the government is detrimental to the interest of the government, but always accept (and often insist) on reduced costs.

Contractors avoid voluntary cost accounting changes because this action could result in the government seeking downward contract price adjustments, and not allowing offsetting upward adjustments.. Thus, these regulatory provisions can inhibit the implementation of ABC.

Furthermore, FAR 30.602 prescribes that a contractor who makes a voluntary cost accounting change must submit a cost impact proposal in order to determine if it results in increased costs to the government. Cost impact statements are onerous to prepare, require substantial efforts, and only within the past few years has the CAS Board attempted to promulgate a standardized format. Because an ABC application generally will result in substantial cost accounting changes, contractors can be so daunted by the "dreaded" cost impact statement, that they are discouraged from applying ABC concepts. A cost impact statement is not necessary for contract administration if the cost accounting change is deemed desirable and not detrimental to the government.

The DoD should supplement the DoD CAS Working Group to state that the cost accounting changes due to ABC implementation are considered desirable and not detrimental to the interest of the government. The DoD should seek an exemption from the CAS Board for cost impact statements for ABC applications.

2. Truth-in Negotiations Act. Public Law 87-653, known as the Truth-in-Negotiations Act and defective pricing, requires that contractors certify that cost or pricing data is accurate, complete, and current as of the date of price agreement on most negotiated contracts. During the implementation of an ABC application, the ultimate impact of a developing ABC application on a contract price is unlikely to be ascertainable. A subsequent reduction in contract costs due to the ABC application might be viewed by government officials to represent a violation of the law due to a lack of disclosure of the details of an ABC application on the date of contract price agreement.

ABC cost drivers are frequently based on (1) budgetary data as opposed to historical factual data, (2) non-financial measures such as number of purchase orders, (3) surveys to establish employees time distribution rather than time cards or time sheets, (4) projections or similar data that might be considered unsupported by DoD auditors. After an ABC application has been developed, these cost drivers are utilized during an accounting period without revision for the actual data experienced during the year. Failure to update cost drivers for actual experience during an accounting period might be considered defective pricing by government personnel. Differences between actual time recording and surveys might also be considered defective pricing.

The DoD should request contractors to provide periodic, interactive briefings on the status of any ABC application and, in turn, unconditionally accept the disclosures at these briefings as compliance with the requirement to provide accurate, complete and current cost or pricing data as related to ABC applications. After an ABC application is developed, DoD should issue audit guidance to provide for acceptance of surveys and similar data generated in a systematic manner to support an ABC application in lieu of actual experience. Likewise, DoD auditors and contracting officers should be advised that for cost drivers, cost and pricing data will be considered current, accurate, and complete as of the date the cost drivers were developed rather than the date of price agreement.

3. Cost of Money Computations. FAR 31.205-11 on depreciation essentially bases depreciation on historical costs whereas many ABC applications use replacement costs or market value. Furthermore, FAR 31/205-10 and CAS 9904.414 establish an allowable imputed cost of money computed on the net book value of assets and the interest rate established by Public Law 92-41. According to these regulations, this cost is allocated using the same allocation bases used to allocate indirect costs. Generally, ABC applications will greatly increase the number and complexity of indirect cost pools and these pools will not be allocated on the same basis as the cost of money would be. Following this requirement for a company with an ABC system would result in significant administrative efforts for a relatively small amount of cost.

As to depreciation, the DoD should revise FAR 31.205.11, Depreciation, to permit use of replacement costs or market value for ABC applications or for all circumstances. As to Cost of Money, The DoD should (1) seek a revision to or interpretation of CAS 414,

"Cost of Money as an Element of the Cost of Facilities Capital," to permit an appropriate statistical measure to substitute for the prescribed allocation base units as is presently provided for process cost accounting systems or (2) revise the profit guidelines to permit deletion of cost of money and correspondingly increase other profit factor(s). .

4. Gains and Losses on Disposition of Assets. FAR 31.205-16 requires that gains and looses on the disposition of tangible capital assets be credited or charged to the cost grouping(s) in which the depreciation applicable to those assets was included. In an ABC application the cost grouping are significantly altered and because ABC tries to "smooth out the lumps" in costs, such looses or gains are typically allocated over the life of the equipment as an ongoing cost. Thus, it is no longer feasible to allocate gains and losses to the same cost grouping(s) where the related depreciation charges were allocated.

The DoD should (1) revise FAR 31.205-16, "Gains and Losses on Disposition or Impairment of Depreciable Property or Capital Assets," to permit allocation of gains and losses to any new cost groupings established by an ABC implementation or (2) revise FAR 31.205-16 to eliminate gains or losses for allowable costs and credits for ABC applications or for all circumstances.

5. Allocation of Independent Research & Development (IR&D) and Bid & Proposal (B&P) Costs. CAS 420, Accounting for Independent Research & Development and Bid & Proposal Costs, requires that the allocation base for these costs be the same as the allocation base for General and Administrative (G&A) expenses. FAR 31.205-18 (b) (2) (I.) contains a similar requirement but permits the contracting parties to negotiate an alternative allocation base if the mandated base is inequitable. An ABC application could result in an allocation of these costs on an allocation base(s) that is not the same as the G&A allocation base(s). For example, some costs may be assigned based on activity measures and others more appropriately assigned on the base(s) used to allocate G & A.

The DoD should request the CAS Board to amend CAS 420 to permit an alternative base for ABC applications and should revise FAR 31.205-18 (b) (2) (I.) to likewise permit an alternative base under these conditions.

6. Allocation of General and Administrative Expenses. CAS 410, "Allocation of Business Unit G&A Costs to Final Cost Objectives," requires that (1) the G & A pool be purified, i.e., if an individual cost can be better allocated on a measure of casual or beneficial relationships, it should be removed from the G & A pool and (2) the allocation base for G&A expenses must be a measure of cost input that best represents total business activity. The three primary variations of cost input are (1) total cost input, (2) value added (total costs less material and subcontracts), and (3) a single element of cost input, such as direct labor dollars. An ABC application could result in an allocation of G&A costs on other than a cost input base. To the extent that the base represents activity and a casual or beneficial relationship, this not be a problem. However, the allocation of any G & A cost pool on other than the three bases identified would conflict with the regulations.

The DoD should request the Cost Accounting Standards (CAS) Board to amend CAS 410 to permit an alternative base for Activity Base Costing applications.

7. Training for Administrative Contracting Officers. The Defense Contract Audit Agency (DCAA) Contract Audit Manual (DCAM) Chapter 14 provides DoD contract

auditors with guidance on Advanced Cost Management Systems (ACMS), which encompasses ABC. The guidance has provided a framework for mutual cooperation and coordination regarding contractor ABC applications. In the administration of DoD contracts, the ACO has much of the decision making responsibilities regarding the cost matters and should have comparable guidance.

The DoD should provide Activity Based Costing guidance and training for Administrative Contracting Officers consistent with the existing DoD audit guidance.

8. Establish Definitive Timing for Government CAS Actions. FAR 30.602-3 establishes specific deadlines for contractor actions related to CAS voluntary cost accounting changes, including those changes resulting from ABC implementation. On the other hand, government deadlines are either absent or subjectively set forth with terms such as "promptly." Unfamiliarity with ABC will likely require additional government review and further extend the time taken for government actions.

The DoD should revise FAR 30.602-3 to set definitive deadlines for government as well as contractor actions related to Cost Accounting Standards.

9. Consistency in Allocating Costs Incurred for the Same Purpose. CAS 402, "Consistency in Allocating Costs Incurred for the Same Purpose," and FAR 31.203 (a) require that, with rare exceptions, contractor costs incurred for the same purpose and under like circumstances shall be allocated as either a direct cost or an indirect cost. ABC applications generally result in more finite allocations that will likely raise more questions regarding consistency. For example, some depreciation may be charged direct as a usage cost and other depreciation may be allocated by an indirect cost grouping. The DCAM at paragraph 14-808 cautions DCAA auditors that when reviewing an ACMS, special care could be given to not permit a cost to be allocated direct unless all such costs are allocated direct. This guidance may tend to bias DCAA auditors against accepting significant direct charging that will likely occur with ABC.

The DoD should amend the Defense Contact Audit Manual to reflect the fact that Cost Accounting Standards provide that both direct and indirect allocation of a cost incurred for the same purpose is an acceptable practice when the cost is incurred under unlike circumstances.

10. Consistency in Estimating, Accumulating, and Reporting Costs. CAS 401, Consistency in Estimating, Accumulating, and Reporting Costs, generally requires that costs must be estimated in proposals in a manner that is consistent with the method by which costs are accumulated in the books and records. However, the grouping of homogeneous costs in estimates prepared for proposal purposes shall not per se be deemed an inconsistent application of cost accounting practices when such costs are accumulated and reported in greater detail on an actual cost basis during contract performance. Grouping of homogeneous costs for estimating purposes will become more prevalent in an ABC application because of increases in the amount of detail in the accumulation of costs.

The DoD should issue Cost Accounting Standards implementation guidance to assure acceptance of the increased frequency of homogeneous cost groupings for estimating purposes due to Activity Based Costing applications.

Summary. The preceding recommendations are presented in order of significance. The first recommendation on voluntary cost accounting changes is as vital to encouraging ABC applications as the remaining nine recommendations combined. Declaring that contractor voluntary cost accounting changes resulting from ABC implementation are desirable and not detrimental to the government's interest is both consistent with a DoD goal of encouraging ABC and within the authority of the DoD. The CAS Board has established overall criteria; however, DoD has for about 20 years provided detailed criteria for determining what is desirable or not detrimental to the government interest.

Recommendation 2 on the Truth-in-Negotiations Act and price proposal support is also very necessary. In order to help the implementation of this recommendation, the DoD could incorporate some additional assurances that violations of the Act are not summarily dismissed. The objective of this recommendation is not to relieve contractors of their responsibility to provide accurate, complete and current cost or pricing data, but to recognize and relieve the burden of attempting to quantify the eventual impact of a developing ABC application each time a contract price is negotiated. Recommendations 3 (depreciation and cost of money and 4 (gains/losses on disposition of property or assets) are necessary to preclude additional administrative efforts due to an ABC application.

Recommendations 5 (IR&D and B&P costs) and 6 (G&A costs) are needed to permit alternative cost allocation bases under ABC. Recommendation 7 on the training of ACOs on timing is important to avoid prolonged contract administration discussions that could lead to disputes. Recommendation 8 on the timing of government actions would greatly ease administrative burdens. Recommendation 9 & 10 on consistency would help avoid misunderstandings and disputes.

Recommendations 7 (IR&D and B&P costs) and 8 (G&A costs) are not crucial because of the unlikelihood that ABC applications will result in a need for alternative cost allocation bases. Recommendations 9 and 10 on consistency would help avoid misunderstandings and disputes.

9.5 Rules for a Successful ABC project

Activity Based Costing models are a tool for operations, not an alternate way of looking at the books. The more involved the operations people were, the more successful the project was.

Company participation in data collection is crucial.

The art of creating a good ABC model is to keep it simple but relevant. Keep detail where it is needed to highlight differences is cost, but remember that detail adds complexity, so don't add detail that is not absolutely necessary.

Off-line models are better than on-line models. Having on-line data available creates a huge temptation to update costs too frequently. Short term fluctuations in volume and efficiency should be ignored. Only long-term trends and their plans should be considered when setting costs. An off-line model will also allow you the freedom to include costs that are not in the income statement such as inventory investment or potential environmental costs. This ability is often vitally important.

There is a lot of interest in ABC in small manufacturing companies. The initial interest is almost always in getting a "better" quoting process. By the end of the project, strategic and managerial issues have become at least as important as better estimating.

You can't have too much training and support. An ABC model is a big jump in sophistication. Most small companies do not understand their cost structures or existing accounting systems all that well.

Not every company is ready for a full ABC model. We are now offering a smaller simpler service to SMEs to build an activity-based quoting template only. This is less expensive for the company, less difficult to understand, and a good starting point.

Sell the operations people on the value of the ABC information to them. Make them the "owners" of the model at completion of the project

Document the model very completely

Spend time to teach the company personnel how to read and use the model

Make the model as easy to read and understand as possible. We are working with several of our case companies to simplify and make more readable their models.

Approach the project as an iterative process - i.e. assume that you will need to help the client revise the model several times before they are satisfied with it.

9.6 The Link between ABC and Target Costing

Target Costing has been a very successful trend in several automotive companies in particular by Toyota. DoD is interested in adapting this technique to the defense community. Target costing as practiced by Toyota means that as Toyota designs a new vehicle, it sets both performance and cost targets that need to be met both by internal designers and external suppliers. It would obviously be easy to ask for undoable targets and thus fail, but Toyota has been very good at selecting goals that are a stretch but are achievable. They do this be carefully tracking the present costs, new trends in technology and production that might affect that part or subsystem, and by rarely trying to make revolutionary changes in any part of the car.

The DoD is likely to have more difficulty implementing Target Costing because many of their products are or include parts that are revolutionary. This makes estimating a reasonable cost much more difficult. The only practical way to estimate costs is to use and activity based costing approach. By dividing the cost into a series of activities, those activities can be estimated and a reasonable accurate cost established. The advantage of using ABC is that you can handle some very different parts of subsystems. Even very revolutionary parts will have some common activities involved in making them, and the educated guesses can be contained to only those areas that are truly different. Even then the magnitude of the uncertainty can be better controlled and understood. So, creating an ABC model of costs is a needed first step toward using Target Costing for DoD products.

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MESSAGE/COMMENTS:

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